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5. Summary: Building CPP-603 in the southern part of INTEC will be decontaminated and dismantled through the Decontamination and Dismantlement (D&D) Program. The primary objectives of these analyses are to (1) show whether or not leaving the currently estimated contaminant inventories in place would be acceptable, and (2) calculate the amount of waste that can be left in CPP-603 without posing an unacceptable risk or hazard to human health. For this report, waste acceptance criteria (WAC) is the term used to represent the acceptable residual inventory that can remain in the CPP-603 facility after closure. The primary task of this project was to develop a model that allows for the calculation of residual WAC inventories for the closed CPP-603 facility. The primary products of the project are the computational tools developed for calculating this WAC and this report. The computational tools are useful for evaluating management alternatives such as partial inventory removal or controlling more of the land so that the receptor is further downgradient.				
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1. INTRODUCTION

Building CPP-603 in the southern part of INTEC will be decontaminated and dismantled through the Decontamination and Dismantlement (D&D) Program. The primary objectives of this analysis are to (1) show whether or not leaving the currently estimated contaminant inventories in place would be acceptable, and (2) calculate the amount of waste that can be left in CPP-603 without posing an unacceptable risk or hazard to human health. For this report, waste acceptance criteria (WAC) is the term used to represent the acceptable residual inventory that can remain in the CPP-603 facility after closure.

The primary task of this project was to develop a model that allows for the calculation of residual WAC inventories for the closed CPP-603 facility. The primary products of the project are the computational tools developed for calculating this WAC and this report. The computational tools are useful for evaluating management alternatives such as partial inventory removal or controlling more of the land so that the receptor is further downgradient.

2. APPROACH

The basic conceptual model and associated parameters chosen for the CPP-603 model are consistent with the ICDF-CA model (DOE-ID 2002). A unit mass or activity of each contaminant is used to calculate the resulting concentration at a receptor location. This concentration is then compared with a limiting concentration calculated based on a cancer risk of 10^{-4} or 10^{-6} or a hazard index equal to one. Using this information, a WAC inventory for each contaminant is calculated and compared with the projected inventory in the CPP-603 facility.

The following assumptions were made for the analysis:

- The groundwater pathway is assumed to be the only significant contaminant exposure pathway.
- The contaminants of concern simulated were chosen from the CPP-603 evaluation presented in EDF-1962 plus C-14, I-129, and Tc-99. If additional contaminants of concern are identified, the model can easily be updated and used in the planning process.
- The estimated current inventory in the CPP-603 facility will be left in place.
- CPP-603 will be grouted so that the contaminant inventory left in place will be in a grouted waste form. The sludge left in the basins after D&D is assumed to be the only significant contaminant source. A small amount of activated metal will also remain (tools and fuel end pieces), but are assumed to be insignificant contributors to the source, after 500 years of decay.
- No contaminant diffusion from the grouted source.
- The grouted waste form will immobilize the contaminants for 500 years and then fail instantaneously.
- After failure of the grouted source, water will move through the grout at a rate of 1 cm/yr, which is equal to the estimated infiltration rate through undisturbed soils at the INEEL. This assumption corresponds to a soil cover that reduces infiltration to the background rates.
- The sludge left in the basins after D&D is the only significant contaminant source. A small amount of activated metal will also remain (tools and fuel end pieces), but are insignificant contributors to the source, after 500 years of decay.
- The source thickness is 0.6 m (2 ft), which is the estimated thickness of the contaminated sludge that will be mixed with the grout during decontamination and grouting. Above the contaminated portion of grout will be clean grout that will isolate the contaminated grout from the ground surface.
- Water and contaminants move straight down through the vadose zone sediments. The contaminant velocity through the sediments depends on the contaminant specific sediment Kd. There is no retardation effect from the basalt and there is no horizontal spreading in the vadose zone. Based on the results of the calibration to the RI/BRA model (Rodriguez et al. 1997), the absence of lateral spreading is a conservative assumption.
- Soil-water partition coefficients (Kd) are consistent with the Kd values used in the ICDF-CA modeling (DOE-ID 2002).

- The contaminant solubility is conservatively assumed to be infinite for these analyses. If a contaminant appears to pose a significant risk to the groundwater quality, then a reasonable solubility limit could be identified and incorporated into the analysis in the future.
- WACs for radionuclides are calculated based on limiting aquifer concentrations corresponding to a 10^{-4} and 10^{-6} risk.
- WACs for nonradionuclides are calculated based on limiting aquifer concentrations corresponding to a hazard index of 1, a risk of 10^{-6} , or an MCL.
- The receptor is assumed to be 100-m downgradient from the edge of the CPP-603 facility.
- The WACs are based on a predicted peak aquifer concentration regardless of the time of peak. In some cases, the WAC would be much lower if the timeframe of interest was reduced to 1,000 or 10,000 years.
- Where available, the WACs are compared with the expected contaminant inventories.
- GWSCREEN (Rood 1999) is used for the source release and contaminant transport simulations.

The conceptual model used for the analysis is shown in Figure 2-1. The parameter values used in the GWSCREEN simulations that are not contaminant specific are shown in Table 2-1. The contaminant specific parameter values are shown in Tables 2-2 for the non-radionuclides and 2-3 for the radionuclides.

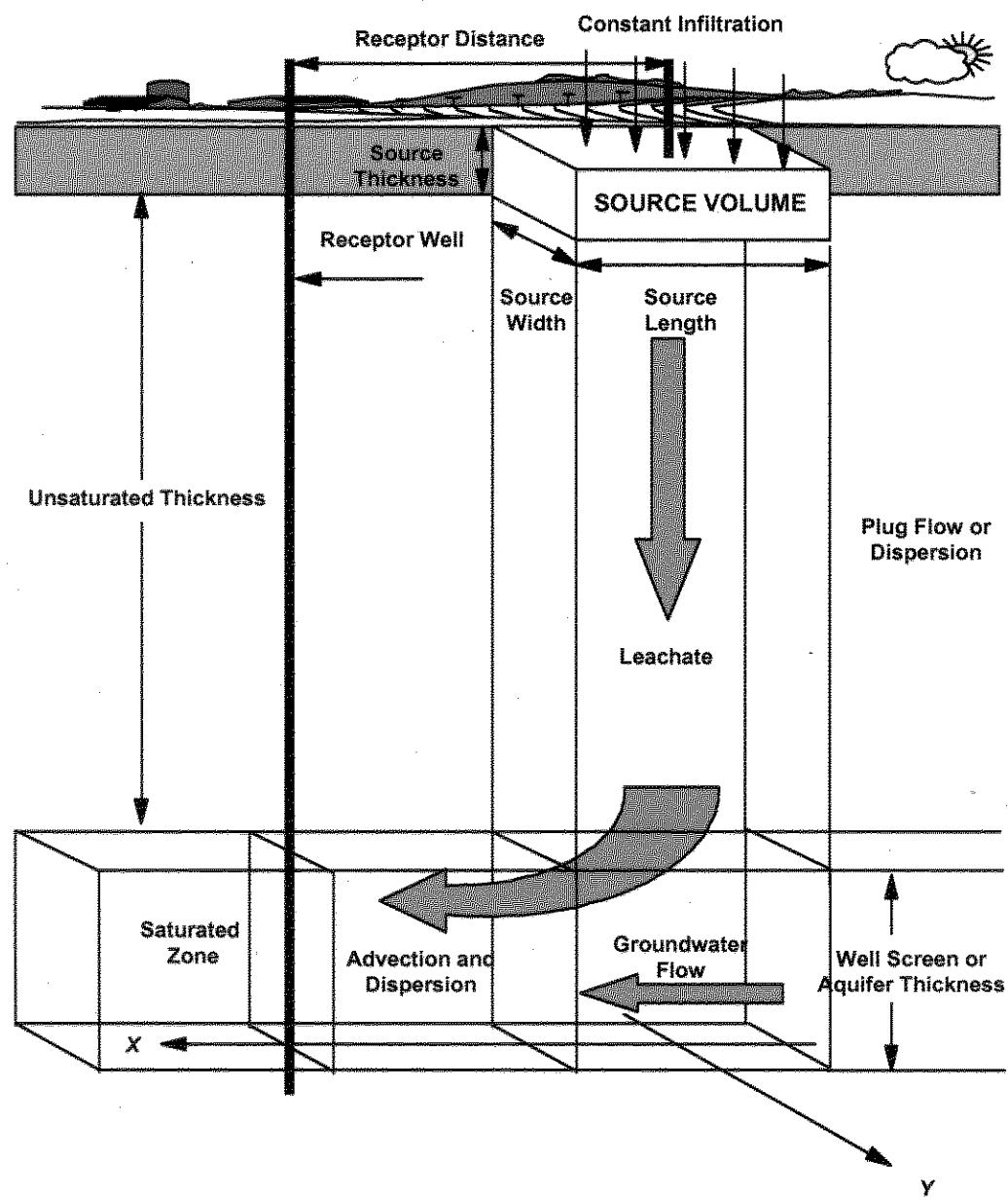


Figure 2-1. Conceptual model of GWSCREEN for the source volume, unsaturated zone, and aquifer (Rood 1999).

Table 2-1. Constant parameter values used in the CPP-603 GWSCREEN simulations.

Parameter	Values	Values	Source of Parameter Values
SOURCE			
Length (CPP-603)	42.9 m	140.7 ft	CPP-603 design (EDF-1962)
Width (CPP-603)	21.4 m	70.2 ft	CPP-603 design (EDF-1962)
Thickness (CPP-603)	0.6 m	2 ft	CPP-603 design (EDF-1962)
Bulk Density	1.5 g/cm ³		ICDF-CA (DOE-ID 2002)
Moisture content	0.3		RI/BRA (Rodriguez et al. 1997)
Infiltration Rate			
0-500 years	0 m/y	0 in/y	ICDF-CA (DOE-ID 2002)
500 years and after	0.01 m/y	0.4 in/y	ICDF-CA (DOE-ID 2002)
UNSATURATED ZONE			
Thickness (cumulative interbeds)	22.7 m	74.5 ft	ICDF-CA (DOE-ID 2002)
Longitudinal Dispersivity	2.92 m	9.6 ft	ICDF-CA (DOE-ID 2002)
Bulk Density	1.36 g/cm ³		ICDF-CA (DOE-ID 2002)
Moisture content	0.3		Calculated in GWSCREEN
AQUIFER			
Thickness	76 m	250 ft	ICDF-CA (DOE-ID 2002)
Well Screen Thickness	15 m	49.2 ft	Track 2 Guidance Document (DOE 1994)
Darcy Velocity	21.9 m/y	71.85 ft/y	ICDF-CA (DOE-ID 2002)
Average Linear Velocity	365 m/y	1200 ft/y	calculated
Porosity	0.06		ICDF-CA (DOE-ID 2002)
Bulk Density	2.49 g/cm ³		ICDF-CA (DOE-ID 2002)
Variable Longitudinal Dispersivity	4.9 m		Calculated in GWSCREEN at 100 m from CPP-603
Ratio Transverse / Longitudinal	0.2		ICDF-CA (DOE-ID 2002)
Ratio Vertical / Longitudinal	0.00116		ICDF-CA (DOE-ID 2002)
Receptor Distance from the Center of the Source			
x (along flow direction)	121.45 m	398 ft	100 m downgradient of CPP-603
y (perpendicular to flow direction)	0 m	0 ft	Along the line of maximum concentration

Table 2-2. Nonradionuclide contaminant-specific parameter values used in the CPP-603 analysis.

COPCs	Reference Dose or Slope Factor	Hazard or Risk Based Limiting Concentration ^e	CPP-603 Inventory ^a	Soil-Water Partition Coefficient		
				Soil	Aquifer Basalt	Concrete
	(mg/kg/d) or (mg/kg/d) ⁻¹	mg/L	mg	mL/g	mL/g	mL/g
Acetone	1.00E-01	3.56E+00	3.0E+05	0	0	0 ^d
Benzene	2.90E-2(SF)	2.93E-03	1.1E+04	0.2	0.008	0.2 ^d
Bromomethane	1.40E-03	5.11E-02	2.1E+03	NA	NA	NA
2-Butanone	6.00E-01	2.19E+01	3.6E+03	NA	NA	NA
1,1-Dichloroethene	NA	7E-03(MCL)	3.3E+03	0.19	0.0076	0.19 ^d
Methylene Chloride	7.50E-3(SF)	1.13E-02	3.3E+03	0.026	0.00104	0.026 ^d
4-Methyl-2-pentanone	NA	NA	3.5E+03	NA	NA	NA
Toluene	2.00E-01	7.30E+00	6.0E+03	1	0.04	1 ^d
m- and p-Xylene	2.00E+00	7.30E+01	7.2E+03	3	0.12	3 ^d
O-Xylene	2.00E+00	7.30E+01	3.4E+03	NA	NA	NA
Styrene	2.00E-01	7.30E+00	3.8E+03	NA	NA	NA
Aluminum	1.00E+00	3.65E+01	3.9E+09	250	10	250 ^d
Arsenic	1.50E+0(SF)	5.67E-05	1.8E+06	3	0.12	3 ^d
Barium	7.00E-02	2.56E+00	1.9E+07	50	2	50 ^d
Beryllium	4.30E+0(SF)	1.98E-05	3.8E+04	250	10.	250 ^d
Cadmium	1.00E-03	3.65E-02	2.3E+07	6	0.24	23 ^b
Chloride	NA	2.5E+2(MCL)	7.9E+07	0	0	1 ^c
Chromium	5.00E-03	1.83E-01	7.2E+07	1.2	0.048	1.2 ^d
Lead	NA	1.5E-2(MCL)	9.5E+07	100	4	100 ^d
Mercury	1.00E-04	3.65E-03	5.3E+01	100	4	60 ^b
Nickel	2.00E-02	7.30E-01	1.5E+06	100	4	100 ^c
Selenium	5.00E-03	1.83E-01	6.0E+05	4	0.16	4 ^d
Silver	5.00E-03	1.83E-01	3.9E+04	90	3.6	90 ^d
Uranium	3.00E-03	1.10E-01	1.1E+07	6	0.24	2500 ^b
Zinc	3.00E-01	1.10E+01	1.4E+09	16	0.64	16 ^d

a. From Demmer, R., 1996, "Basin Sludge Calculations for CPP-603 Fuel Basins", RLD-08-96, letter report to Thorton Waite from Rick Demmer, Dated Aug. 20, 1996.

b. From DOE (2000), Table 1.

c. From Krupka and Serne (1998), Table 5-1.

d. No concrete Kd information available. The soils Kd value was used.

e. The hazard and risk based limiting concentrations are calculated based on the reference dose or slope factor and exposure parameters.

NA - not available – assume Kd=0 for the soils and aquifer basalt.

SF - limiting concentration is based on a slope factor. The others are based on a reference dose. The slope factors are taken from the tables in Rodriguez et al., 1997 in order to be consistent with the OU 3-13 Comprehensive RI/BRA.

MCL - maximum drinking water concentration limit based on 40CFR 141.61.

Table 2-3. Radionuclide contaminant-specific-parameter values used in the GWSCREEN Analysis.

COPCs Parent / Progeny	Radioactive Half-Life	Slope Factor ^c	10^{-6} Risk Based Water Conc ^e	CPP-603 Inventory ^f	Soil-Water Partition Coefficient (Kd) ^a		
					Soil	Aquifer	Concrete
			(Ci)		(mL/g)	(mL/g)	(mL/g)
Am-241	432	3.28E-10	1.46E-01	4.20E-02	340	13.6	5000
	Np-237	2.14E+06	3.00E-10		8	0.32	
	U-233	1.59E+05	4.48E-11		6	0.24	
	Th-229	7340	3.56E-10		100	4	
C-14	5.73E+03	1.03E-12	4.62E+01	1.0 ^d	0.1	0.004	10
I-129	1.57E+07	1.84E-10	2.59E-01	1.0 ^d	0.1	0.004	2
Nb-94	2.03E+04	6.91E-12	6.89E+00	1.0E+00	8	0.32	1000 ^b
Np-237	2.14E+06	3.00E-10	1.60E-01	5.0E-03	8	0.32	5000
	U-233	1.59E+05	4.48E-11		6	0.24	
	Th-229	7340	3.56E-10		100	4	
Pu-238	87.8	2.95E-10	1.63E-01	4.2E-02	140	5.6	5000
	U-234	2.45E+05	4.44E-11		6	0.24	
	Th-230	7.54E+04	3.75E-11		100	4	
	Ra-226	1600	2.96E-10		100	4	
	Pb-210	22.3	1.01E-09		100	4	
Pu-239	2.41E+04	3.16E-10	1.52E-01	2.2E+00	140	5.6	5000
	U-235	7.04E+08	4.70E-11		6	0.24	
	Pa-231	3.28E+04	1.49E-10		550	22	
	Ac-227	21.8	6.26E-10		450	18	
Pu-240	6.56E+03	3.15E-10	1.51E-01	1.0 ^d	140	5.6	5000
	U-236	2.34E+07	4.21E-11		6	0.24	
	Th-232	1.41E+10	3.28E-11		100	4	
	Ra-228	5.75	2.48E-10		100	4	
	Pb-210	1.91	2.31E-10		100	4	
Tc-99	2.11E+05	1.40E-12	3.40E+01	1.0 ^d	0.2	0.008	1000
U-234	2.45E+05	4.44E-11	1.08E+00	3.0E-01	6	0.24	2000
	Th-230	7.54E+04	3.75E-11		100	4	
	Ra-226	1600	2.96E-10		100	4	
	Pb-210	22.3	1.01E-09		100	4	
U-235	7.04E+08	4.70E-11	1.02E+00	1.2E-02	6	0.24	2000
	Pa-231	3.28E+04	1.49E-10		550	22	
	Ac-227	21.8	6.26E-10		450	18	
U-238	4.47E+09	6.20E-11	7.68E-01	1.7E-03	6	0.24	2000
	U-234	2.45E+05	4.44E-11		6	0.24	
	Th-230	7.54E+04	3.75E-11		100	4	
	Ra-226	1600	2.96E-10		100	4	
	Pb-210	22.3	1.01E-09		100	4	

Note – progeny ingrowth was ignored for the first 500 years.

a. From DOE-ID (2002) the ICDF Composite Analysis.

b. There is no Kd listed in DOE-ID 2002 for Nb. Therefore, the value chosen is from Krupka and Serne (1998), Table 5-1.

c. Slope factors are taken from the tables in Rodriguez et al., 1997 in order to be consistent with the OU 3-13 Comprehensive RI/BRA. They are based on FGR-13.

d. No projected inventory available. Unit inventory used to calculate the WAC.

e. The risk-based concentrations are calculated based on the slope factor and exposure parameters.

f. From Demmer, R., 1996, "Basin Sludge Calculations for CPP-603 Fuel Basins", RLD-08-96, letter report to Thornton Waite from Rick Demmer, Dated Aug. 20, 1996.

Listed below are the major contaminant-specific assumptions:

- The contaminant specific partition coefficient (Kd) values are consistent with those used in the ICDF-CA (DOE-ID 2002), which are based primarily on Track 2 default values (DOE, 1994), which were used in the ICPP RI/BRA report (Rodriguez et. al., 1997). In general, these are conservative screening-level values, where:
 - For chemicals where no Kd could be found, a conservative value of 0 mL/g was assumed.
 - For chemicals for which no concrete Kd values are available, soil Kd values were used. This assumes there is no grouting but the CPP-603 pools are simply filled with soil.
 - In the vadose zone sediments, Kd values are taken from the ICDF-CA (DOE-ID 2002) modeling.
 - In the ICPP RI/BRA report, it was assumed that the aquifer basalt Kd values are 25 times smaller than the assumed soil Kd values. The same assumption was used in the ICDF-CA and this evaluation.
 - The COPCs, initial inventory, and Kd values used in the alluvium and interbeds, aquifer, and concrete, are shown in Table 3-5 and Table 3-6 of the EDF-1962.
- Radionuclide progeny were included in the analysis. The progeny are assumed to move with the parent in the GWSCREEN simulations.

3. RESULTS

In Tables 3-1 and 3-2 are the model predictions, calculated WACs and comparison with the currently estimated and projected residual inventory for the CPP-603 facility. Table 3-1 shows the nonradionuclide results and Table 3-2 shows the radionuclide results. The projected inventories in 500 years are taken from EDF-1962, Tables 3-5 and 3-6. The projected inventory assumes removal of 90% of the estimated inventory and decay of the remaining inventory for 500 years.

As shown in Table 3-1, based on these nonradionuclide inventory estimates used for the EDF-1962, the WACs are significant larger than the inventory. The arsenic WAC ($8.6E+06$ mg) is the closest to the projected inventory ($1.8E+05$ mg).

As shown in Table 3-2, based on the radionuclide inventories projected, the WACs are significantly larger than the inventory. However, there were several radionuclides with no inventory estimates. The WACs calculated for those nuclides can be used to support the planning for closure of CPP-603.

Am-241 and Pu-238 are nuclides that are strongly sorbed but decay relatively quickly to more mobile contaminants (Np-237 and U-234). Therefore, exposure and risk in the aquifer from Am-241 and Pu-238 would come from the progeny Np-237 and U-234, respectfully. The Am-241 and Pu-238 WACs are calculated directly from the Np-237 and U-234 WACs, respectively. The calculation conservatively assumes that the Am-241 and Pu-238 decay instantaneously to Np-237 and U-234, respectively.

Table 3-1. Nonradionuclide WAC results and comparison with projected residual inventory.

	10 ⁻⁶ Risk Based Limiting Concentration	MCL	Predicted Peak Concentration From Unit Inventory	WAC based on Limiting Concentration	WAC based on MCL	Estimated CPP-603 Inventory	Projected CPP-603 Inventory in 500 years ^a
	mg/m ³	mg/m ³	mg/m ³	mg	mg	mg	mg
Acetone	3.56E+03	na	1.00E-07	3.55E+10	na	3.0E+05	3.0E+04
Benzene	2.93E+00	5.00E+00	5.14E-08	5.71E+07	9.74E+07	1.1E+04	1.1E+03
Bromomethane	5.11E+01	na	1.00E-07	5.09E+08	na	2.1E+03	2.1E+02
2-Butanone	2.19E+04	na	1.00E-07	2.18E+11	na	3.6E+03	3.6E+02
1,1-Dichloroethene	7.00E+00	7.00E+00	5.27E-08	1.33E+08	1.33E+08	3.3E+03	3.3E+02
Methylene Chloride	1.13E+01	na	8.93E-08	1.27E+08	na	3.3E+03	3.3E+02
4-Methyl-2-pentanone	na	na	1.00E-07	na	na	3.5E+03	3.5E+02
Toluene	7.30E+03	1.00E+04	1.74E-08	4.20E+11	5.75E+11	6.0E+03	6.0E+02
m- and p-Xylene	7.30E+04	1.00E+04	6.56E-09	1.11E+13	1.52E+12	7.2E+03	7.2E+02
O-Xylene	7.30E+04	1.00E+02	1.00E-07	7.28E+11	9.97E+08	3.4E+03	3.4E+02
Styrene	7.30E+03	1.00E+03	1.00E-07	7.28E+10	9.97E+09	3.8E+03	3.8E+02
Aluminum	3.65E+04	2.00E+02	8.41E-11	4.34E+14	2.38E+12	3.9E+09	3.9E+08
Arsenic	5.67E-02	5.00E+01	6.56E-09	8.65E+06	7.63E+09	1.8E+06	1.8E+05
Barium	2.56E+03	2.00E+03	4.19E-10	6.11E+12	4.77E+12	1.9E+07	1.9E+06
Beryllium	1.98E-02	4.00E+00	8.41E-11	2.35E+08	4.76E+10	3.8E+04	3.8E+03
Cadmium	3.65E+01	5.00E+00	3.26E-09	1.12E+10	1.54E+09	2.3E+07	2.3E+06
Chloride	2.50E+05	2.50E+05	9.19E-08	2.72E+12	2.72E+12	7.9E+07	7.9E+06
Chromium	1.83E+02	1.00E+02	1.49E-08	1.23E+10	6.70E+09	7.2E+07	7.2E+06
Lead	1.50E+01	1.50E+01	2.10E-10	7.14E+10	7.14E+10	9.5E+07	9.5E+06
Mercury	3.65E+00	2.00E+00	2.10E-10	1.74E+10	9.51E+09	5.3E+01	5.3E+00
Nickel	7.30E+02	1.00E+02	2.10E-10	3.48E+12	4.76E+11	1.5E+06	1.5E+05
Selenium	1.83E+02	5.00E+01	5.00E-09	3.66E+10	1.00E+10	6.0E+05	6.0E+04
Silver	1.83E+02	1.00E+02	2.33E-10	7.85E+11	4.29E+11	3.9E+04	3.9E+03
Uranium	1.10E+02	3.00E+01	2.76E-10	3.99E+11	1.09E+11	1.1E+07	1.1E+06
Zinc	1.10E+04	5.00E+03	1.30E-09	8.47E+12	3.85E+12	1.4E+09	1.4E+08

a. The projected inventory assumes 90% source term removal before closure (EDF-1962).

Table 3-2. Radionuclide WAC results and comparison with projected residual inventory.

		Predicted From Unit Inventory		Risk Based WAC		CPP-603 Inventory	
	Radioactive decay half life	Time of Peak Conc.	Peak Conc.	10^{-6} Risk	10^{-4} Risk	Current Estimate ^a	Projected in 500 Years ^b
	(Years)	(Years)	(Ci/m ³)	(Ci)	(Ci)	(Ci)	(Ci)
Am-241 (Np)	4.32E+02	6.4E+4 (Np)	0.00E+00	5.23E+03 ^c	5.23E+05 ^c	4.20E-02	1.90E-03
Np-237	2.14E+06		0.00E+00				
U-233	1.59E+05		0.00E+00				
Th-229	7.34E+03		0.00E+00				
C-14	5.73E+03	1.27E+03	2.99E-08	1.55E+00	1.55E+02	Not estimated	Not estimated
I-129 ^d	1.57E+07	9.45E+02	6.01E-08	4.31E-03	4.31E-01	Not estimated	Not estimated
Nb-94	2.03E+04	2.97E+04	1.63E-10	4.24E+01	4.24E+03	1.00E+00	9.80E-02
Np-237	2.14E+06	6.40E+04	1.41E-10	1.06E+00	1.06E+02	5.00E-03	5.00E-04
U-233	1.59E+05		4.50E-11				
Th-229	7.34E+03		2.52E-12				
Pu-238 (U)	8.78E+01	4.00E+04(U)	0.00E+00	6.22E+03 ^c	6.22E+03 ^c	4.20E-01	8.10E-04
U-234	2.45E+05		0.00E+00				
Th-230	7.54E+04		0.00E+00				
Ra-226	1.60E+03		0.00E+00				
Pb-210	2.23E+01		0.00E+00				
Pu-239	2.41E+04	1.71E+05	3.21E-14	4.61E+03	4.61E+05	2.20E+00	2.20E-01
U-235	7.04E+08		3.15E-15				
Pa-231	3.28E+04		3.49E-17				
Ac-227	2.18E+01		4.27E-17				
Pu-240	6.56E+03	9.04E+04	3.59E-18	3.46E+06	3.46E+08	Not estimated	Not estimated
U-236	2.34E+07		3.00E-16				
Th-232	1.41E+10		7.84E-23				
Ra-228	5.75E+00		7.84E-23				
Th-228	1.91E+00		7.84E-23				
Tc-99	2.11E+05	3.96E+03	7.63E-10	4.46E+01	4.46E+03	Not estimated	Not estimated
U-234	2.45E+05	4.00E+04	2.98E-10	2.23E+00	2.23E+02	3.03E-01	3.03E-02
Th-230	7.54E+04		6.35E-12				
Ra-226	1.60E+03		6.06E-12				
Pb-210	2.23E+01		6.05E-12				
U-235	7.04E+08	4.41E+04	3.36E-10	2.65E+00	2.65E+02	1.20E-02	1.20E-03
Pa-231	3.28E+04		2.44E-12				
Ac-227	2.18E+01		2.98E-12				
U-238	4.47E+09	4.41E+04	3.36E-10	2.06E+00	2.06E+02	1.70E-03	1.70E-04
U-234	2.45E+05		3.95E-11				
Th-230	7.54E+04		4.70E-13				
Ra-226	1.60E+03		4.27E-13				
Pb-210	2.23E+01		4.26E-13				

a. From Table 3-2 in EDF-1962.

b. Assumes 90% source removal before CPP-603 closure and radioactive decay for 500 years (EDF-1962).

c. Am-241 WAC is the Np-237 WAC converted into activity of Am-241 and the Pu-238 WAC is the U-234 WAC converted into activity of Pu-238. Based on just risk from Am-241 and Pu-238, the WACs would be infinite.

d. Based on an I-129 MCL of 1 pCi/L, the WAC would be 0.017 Ci.

4. SENSITIVITY TO CONCRETE Kd VALUES

For purposes of assigning Kd values to the source, the analysis for the nonradionuclides generally assumed that the CPP-603 facility would be filled with soils rather than grout while the radionuclide analysis assumed grout Kds that are in many cases much greater than the soils Kd. As a sensitivity analysis, the WACs for the radionuclides were recalculated assuming that the grout Kd is decreased by a factor of 10. The results are shown in Table 4-1. Comparing the WACs presented in Table 3-2 and 4-1, the WACs decreased from between a factor of 1.1 (I-129) and 8.7 (Pu-240) with a decrease in the radionuclide source Kd of 10.

Table 4-1. Radionuclide WAC results and comparison with projected residual inventory if the source (concrete) Kd is decreased by 10.

		Predicted From Unit Inventory		Risk Based WAC		CPP-603 Inventory	
	Radioactive decay half life (Years)	Time of Peak Conc. (Years)	Peak Conc. (Ci/m ³)	10 ⁻⁶ Risk (Ci)	10 ⁻⁴ Risk (Ci)	Current Estimate ^a (Ci)	Projected in 500 Years ^b (Ci)
Am-241 (Np)	4.32E+02	4.05E+04	0.00E+00	8.32E+0 ^c	8.32E+04 ^c	4.20E-02	1.90E-03
Np-237	2.14E+06		0.00E+00				
U-233	1.59E+05		0.00E+00				
Th-229	7.34E+03		0.00E+00				
C-14	5.73E+03	8.34E+02	5.88E-08	7.87E-01	7.87E+01	Not estimated	Not estimated
I-129	1.57E+07	7.68E+02	6.78E-08	3.82E-03	3.82E-01	Not estimated	Not estimated
Nb-94	2.03E+04	2.32E+04	8.35E-10	8.26E+00	8.26E+02	1.00E+00	9.80E-02
Np-237	2.14E+06	4.05E+04	9.06E-10	1.68E-01	1.68E+01	5.00E-03	5.00E-04
U-233	1.59E+05		1.92E-10				
Th-229	7.34E+03		9.55E-12				
Pu-238 (U)	8.78E+01	2.59E+04	0.00E+00	1.30E+03 ^c	1.30E+05 ^c	4.20E-01	8.10E-04
U-234	2.45E+05		0.00E+00				
Th-230	7.54E+04		0.00E+00				
Ra-226	1.60E+03		0.00E+00				
Pb-210	2.23E+01		0.00E+00				
Pu-239	2.41E+04	1.61E+05	2.15E-13	6.92E+02	6.92E+04	2.20E+00	2.20E-01
U-235	7.04E+08		1.59E-14				
Pa-231	3.28E+04		1.74E-16				
Ac-227	2.18E+01		2.13E-16				
Pu-240	6.56E+03	8.92E+04	3.10E-17	3.97E+05	3.97E+07	Not estimated	Not estimated
U-236	2.34E+07		2.29E-15				
Th-232	1.41E+10		5.90E-22				
Ra-228	5.75E+00		5.90E-22				
Th-228	1.91E+00		5.90E-22				
Tc-99	2.11E+05	2.73E+03	6.38E-09	5.33E+00	5.33E+02	Not estimated	Not estimated
U-234	2.45E+05	2.59E+04	1.64E-09	4.67E-01	4.67E+01	3.03E-01	3.03E-02
Th-230	7.54E+04		2.36E-11				
Ra-226	1.60E+03		2.18E-11				
Pb-210	2.23E+01		2.17E-11				
U-235	7.04E+08	2.65E+04	1.76E-09	5.23E-01	5.23E+01	1.20E-02	1.20E-03
Pa-231	3.28E+04		9.07E-12				
Ac-227	2.18E+01		1.11E-11				
U-238	4.47E+09	2.65E+04	1.76E-09	4.11E-01	4.11E+01	1.70E-03	1.70E-04
U-234	2.45E+05		1.27E-10				
Th-230	7.54E+04		9.53E-13				
Ra-226	1.60E+03		8.08E-13				
Pb-210	2.23E+01		8.06E-13				

a. From Table 3-2 in EDF-1962.

b. Assumes 90% source removal before CPP-603 closure and radioactive decay for 500 years (EDF-1962).

c. Am-241 WAC is the Np-237 WAC converted into activity of Am-241 and the Pu-238 WAC is the U-234 WAC converted into activity of Pu-238. Based on just risk from Am-241 and Pu-238, the WACs would be infinite.

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5. SUMMARY AND DISCUSSION

A set of computational tools has been developed to simulate the transport of contaminants from the CPP-603 facility after closure. The tools consist of GWSCREEN input files and MS Excel spreadsheet for manipulating the data and presenting the results. Results of this model have been used to calculate WACs for CPP-603. These computational tools are useful for evaluating management alternatives such as partial inventory removal or controlling more of the land so that the receptor is further downgradient, decreasing the concentrations and risk.

Note that the WACs presented in Tables 3-1 and 3-2 are based on the assumption that the receptor is exposed to only one contaminant. The WACs provide a general guideline for which contaminants will dominate the risk but cumulative risk must be calculated in order to demonstrate acceptable performance for a facility. For example, for the radionuclides, the U-234 inventory is less than an order of magnitude smaller than the 10^{-6} risk based WAC while the other radionuclides inventories are much smaller. Therefore, U-234 will dominate the predicted risk during the timeframe of peak U-234 concentration. Assuming all of the radionuclides will peak in the aquifer at the same time, the cumulative risk (based on the radionuclides with projected inventories) is 1.7×10^{-7} and U-234 contributes 80% of that risk. Additional contributions from C-14, I-129, Pu-240, and Tc-99 cannot be included until inventory projections are obtained for those nuclides. In reality, the aquifer concentrations will peak at different times, so this is an upper bound on the risk predicted from the radionuclides with projected inventories. If updates to the projected inventories indicate that the residual contamination will approach the WAC, then a time dependent cumulative risk calculation will be necessary. Since the projected inventory is incomplete at this time, there is insufficient information for a meaningful calculation of the time dependent cumulative risk.

Generally the performance criteria are chosen to be between 10^{-4} risk and 10^{-6} risk. If the cumulative risk is based on the 10^{-4} risk, then the 10^{-6} risk based WAC will almost always be overly conservative. But if the cumulative risk is based on the 10^{-6} risk, then the 10^{-6} risk based WAC will only provide an upper bound for a single contaminant and a sum of fractions calculation will be required to calculate the cumulative risk.

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APPENDIX A: GWSCREEN MODEL RESULTS

GWSCREEN Input Deck – Non-Radionuclides Set #1

Organics - CPP-603 - based on assumptions of ICDF CA modeling
4 3 3 1 1 (Card 2) imode,itype,idisp,kflag,idil
1 1 2 1 2 (Card 3) imodel,isolve,isolveu,imoist,imoistu
6 15 0.01 (Card 4) jstart jmax eps
70. 2.555E+04 2.0 350. 30. 1.0 (Card 5) bw,at,wi,ef,ed,dlim
0. 0. (Card 6) x0,y0
42.9 21.4 0.010 (Card 7) l,w,perc
0.6 1.5 (Card 8b) thick, rhos, (source term values)
0.30 (Card 8c) thetas (source term mc)
22.7 1.359 2.92 (Card 9) depth,rhou,axu
\$ NOTE: The values of depth and axu are the ucode calibrated values
\$ van Genuchten parameters from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
1.066 1.523 21.13 0.487 0.142 (Card 9b) alphau nu ksatu porsu thetaru
\$use calib values for ax and az ay=0.2ax and az=1.16e-3ax as stated in the MEPAS Manual
3.31 0.2 1.163E-3 76. 15. (Card 10) ax,ay,az,b,z(well screen thickness)
\$ Aqui dens and porosity from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
\$ --- Darcy velocity based on an assumed pore vel of ~ 1 m/d in EDF-ER-275
21.9 0.06 2.491 (Card 11) u,phi,rhoa
1 (Card 12a) nrecept
121.45 0. (Card 12b) x y
11 (Card 14) ncontam
\$ ----- Acetone ----- 1
0 0. 0. 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"ace" 1.e12 0. 3.56e3 (card14b) cname thalf kda dcf
\$ ----- Benzene ----- 2
0 0.2 0.2 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"benz" 1.e12 0.008 2.93 (card14b) cname thalf kda dcf
\$ ----- Bromomethane----- 3
0 0. 0. 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"bro" 1.e12 0. 51.1 (card14b) cname thalf kda dcf
\$ ----- 2-Butanone----- 4
0 0.0 0.0 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"2-but" 1.e12 0. 2.19E+04 (card14b) cname thalf kda dcf
\$ ----- 1,1-dichloroethene ----- 5
0 0.19 0.19 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"dichl" 1.e12 0.0076 7. (card14b) cname thalf kda dcf
\$ ----- Methylene chloride----- 6
0 0.026 0.026 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"meth" 1.e12 0.00104 11.3 (card14b) cname thalf kda dcf
\$ ----- 4-methyl-2-pentanone----- 7
0 0.0 0.0 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"4-meth" 1.e12 0. 0.9999 (card14b) cname thalf kda dcf
\$ ----- toluene----- 8
0 1.0 1.0 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"tol" 1.e12 0.04 7300. (card14b) cname thalf kda dcf
\$ ----- m- and p-xylene ----- 9
0 3.0 3.0 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"mp-xyl" 1.e12 0.12 73000. (card14b) cname thalf kda dcf
\$ ----- o-xylene ----- 10
0 0. 0. 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"o-xyl" 1.e12 0. 73000. (card14b) cname thalf kda dcf
\$ ----- Styrene----- 11
0 0. 0. 999 1.0 1.0 1.0E6 0.0 (card14a) nprog kds kdu zmw qi rmi sl other
"styr" 1.e12 0. 7300. (card14b) cname thalf kda dcf

GWSCREEN Output – Non-Radionuclides Set #1

TIME OF RUN: 18:44:17.29 DATE OF RUN: 03/30/03

```
*****
* This output was produced by the model: *
*                                     *
*          GWSCREEN                      *
*          Version 2.5a                   *
*          A semi-analytical model for the assessment   *
*          of the groundwater pathway from the leaching   *
*          of surficial and buried contamination and   *
*          release of contaminants from percolation ponds   *
*          07/16/2002                         *
*          Arthur S. Rood                  *
*          Idaho National Engineering and      *
*          Environmental Laboratory           *
*          PO Box 1625                      *
*          Idaho Falls, Idaho 83415        *
*****
```

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OUTPUT FILE NAME:

unit_nr1.out
INPUT FILE NAME:

unit_nr1.par

Title: Organics - CPP-603 - based on assumptions of ICDF CA modeling

Model Run Options

```
IMODE Contaminant Type and Impacts:          4
ITYPE (1) Vert Avg (2) 3D Point (3) 3d Avg:    3
IDISP (0) Fixed Dispersivity (1-3) Spatially Varying: 3
KFLAG (1) Max Conc (2) Conc vs Time (3) Grid Output: 1
IDIL (1) No dilution factor (2) Include Dilution Factor: 1
IMOIST Source Moisture Content Option:        1
IMOISTU Unsaturated Moisture Content Option:  2
IMODEL (1) Surface/Burried Src (2) Pond (3) Usr Def: 1
ISOLVE (1) Gaussian Quarature (2) Simpsons Rule: (Aquifer) 1
ISOLVEU (1) Gaussian Quarature (2) Simpsons Rule: (Unsat Zone) 2
JSTART: 6
JMAX : 15
EPS  : 1.000E-02
Health Effects: Ratio of groundwater concentration to MCL
Output mass/activity units: mg
Output concentration units: mg/m***3
Dose/Risk Conversion Units: mg/m***3
Output health effects units: Ratio of Cp/Cmcl
Cp = Peak groundwater concentration, Cmcl = Maximum contaminant limit
```

Exposure Parameters

```
Body Mass (kg):      70.      Averaging Time (days): 25550.
Water Ingestion (L/d): 2.000E+00 Exposure Freq (day/year): 3.500E+02
Exposure Duration (y): 3.000E+01 Limiting Dose: 1.000E+00
```

Site Parameters

```
X Coordinate: 0.000E+00 Y Coordinate: 0.000E+00
Source Length (m): 4.290E+01 Source Width (m): 2.140E+01
Percolation Rate (m/y): 1.000E-02
```

Source Thickness (m): 6.000E-01 Src Bulk Density (g/cc): 1.500E+00
Source Moisture Content: 3.000E-01

Unsaturated Zone Parameters

Unsat Zone Thickness (m): 2.270E+01 Unsat Bulk Density: 1.359E+00
Unsat Alpha (1/m): 1.066E+00 Unsat n: 1.523E+00
Saturated K in Unsat (m/y): 2.113E+01 Porosity of Unsat Zone: 4.870E-01
Unsat Residual Moisture: 1.420E-01 Unsat Dispersivity (m): 2.920E+00

Aquifer Zone Parameters

Transverse/Longitud Ratio: 2.000E-01 Vertical/Longitud Ratio: 1.163E-03
Aquifer Thickness (m): 7.600E+01 Well Screen Thickness (m): 1.500E+01
Darcy Velocity (m/y): 2.190E+01 Aquifer Porosity: 6.000E-02
Bulk Density (g/cc): 2.491E+00

Calculated Flow Parameters

Percolation Water Flux (m³/y): 9.1806E+00
Unsaturated Moisture Content: 2.8499E-01
Unsat Pore Velocity (m/y): 3.5089E-02
Aquifer Pore Velocity (m/y): 3.6500E+02

Contaminant Data

Contaminant Name:	ace
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	0.000E+00
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	0.000E+00
Kd Aquifer (ml/g):	0.000E+00
Risk/Dose Conversion Factor:	3.560E+03

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3): 6.0514E-03
Solubility Limited Mass (mg): 1.6525E+11
Unsaturated Retardation Factor: 1.0000E+00
Mean Unsaturated Transit Time (y): 5.6903E+02
Leading Edge Arrival Time (y): 4.4500E+01
Aquifer Retardation Factor: 1.000E+00
Minimum Peak Window Time (y): 4.4601E+01
Maximum Peak Window Time (y): 6.9424E+02

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m**3): 1.004E-07
Time of Peak (y): 5.1272E+02
Concentrations Averaged Between: 4.9772E+02 and 5.2772E+02 years
Average Concentration (mg/m**3): 1.003E-07
Maximum Dose: 2.818E-11
Maximum Allowable Inventory (mg): 3.549E+10

Contaminant Data

Contaminant Name:	benz
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	2.000E-01
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	2.000E-01
Kd Aquifer (ml/g):	8.000E-03
Risk/Dose Conversion Factor:	2.930E+00

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 2.7778E-02
Initial Pore Water Conc (Ci or mg/m**3): 3.0257E-03
Solubility Limited Mass (mg): 3.3050E+11

Unsaturated Retardation Factor: 1.9537E+00
Mean Unsaturated Transit Time (y): 1.1117E+03
Leading Edge Arrival Time (y): 8.6942E+01
Aquifer Retardation Factor: 1.332E+00
Minimum Peak Window Time (y): 8.7076E+01
Maximum Peak Window Time (y): 1.3619E+03

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m³): 5.137E-08
Time of Peak (y): 1.0024E+03
Concentrations Averaged Between: 9.8742E+02 and 1.0174E+03 years
Average Concentration (mg/m³): 5.136E-08
Maximum Dose: 1.753E-08
Maximum Allowable Inventory (mg): 5.705E+07

Contaminant Data

Contaminant Name:	bro
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	0.000E+00
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	0.000E+00
Kd Aquifer (ml/g):	0.000E+00
Risk/Dose Conversion Factor:	5.110E+01

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 5.5556E-02
Initial Pore Water Conc (Ci or mg/m³): 6.0514E-03
Solubility Limited Mass (mg): 1.6525E+11
Unsaturated Retardation Factor: 1.0000E+00
Mean Unsaturated Transit Time (y): 5.6903E+02
Leading Edge Arrival Time (y): 4.4500E+01
Aquifer Retardation Factor: 1.000E+00
Minimum Peak Window Time (y): 4.4601E+01
Maximum Peak Window Time (y): 6.9424E+02

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m³): 1.004E-07
Time of Peak (y): 5.1272E+02
Concentrations Averaged Between: 4.9772E+02 and 5.2772E+02 years
Average Concentration (mg/m³): 1.003E-07
Maximum Dose: 1.963E-09
Maximum Allowable Inventory (mg): 5.094E+08

Contaminant Data

Contaminant Name:	2-but
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	0.000E+00
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	0.000E+00
Kd Aquifer (ml/g):	0.000E+00
Risk/Dose Conversion Factor:	2.190E+04

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 5.5556E-02
Initial Pore Water Conc (Ci or mg/m³): 6.0514E-03
Solubility Limited Mass (mg): 1.6525E+11
Unsaturated Retardation Factor: 1.0000E+00
Mean Unsaturated Transit Time (y): 5.6903E+02
Leading Edge Arrival Time (y): 4.4500E+01
Aquifer Retardation Factor: 1.000E+00
Minimum Peak Window Time (y): 4.4601E+01
Maximum Peak Window Time (y): 6.9424E+02

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m^{**3}): 1.004E-07
Time of Peak (y): 5.1272E+02
Concentrations Averaged Between: 4.9772E+02 and 5.2772E+02 years
Average Concentration (mg/m^{**3}): 1.003E-07
Maximum Dose: 4.581E-12
Maximum Allowable Inventory (mg): 2.183E+11
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY
EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT

Contaminant Data

Contaminant Name:	dichl
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	1.900E-01
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	1.900E-01
Kd Aquifer (ml/g):	7.600E-03
Risk/Dose Conversion Factor:	7.000E+00

Calculated Contaminant Values

Decay Constants (1/y):	6.9315E-13
Leach Rate Constant (1/y):	2.8490E-02
Initial Pore Water Conc (Ci or mg/m ^{**3}):	3.1033E-03
Solubility Limited Mass (mg):	3.2224E+11
Unsaturated Retardation Factor:	1.9060E+00
Mean Unsaturated Transit Time (y):	1.0846E+03
Leading Edge Arrival Time (y):	8.4820E+01
Aquifer Retardation Factor:	1.316E+00
Minimum Peak Window Time (y):	8.4953E+01
Maximum Peak Window Time (y):	1.3285E+03

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m^{**3}): 5.265E-08
Time of Peak (y): 9.7794E+02
Concentrations Averaged Between: 9.6294E+02 and 9.9294E+02 years
Average Concentration (mg/m^{**3}): 5.265E-08
Maximum Dose: 7.521E-09
Maximum Allowable Inventory (mg): 1.330E+08

Contaminant Data

Contaminant Name:	meth
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	2.600E-02
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	2.600E-02
Kd Aquifer (ml/g):	1.040E-03
Risk/Dose Conversion Factor:	1.130E+01

Calculated Contaminant Values

Decay Constants (1/y):	6.9315E-13
Leach Rate Constant (1/y):	4.9164E-02
Initial Pore Water Conc (Ci or mg/m ^{**3}):	5.3552E-03
Solubility Limited Mass (mg):	1.8673E+11
Unsaturated Retardation Factor:	1.1240E+00
Mean Unsaturated Transit Time (y):	6.3958E+02
Leading Edge Arrival Time (y):	5.0018E+01
Aquifer Retardation Factor:	1.043E+00
Minimum Peak Window Time (y):	5.0123E+01
Maximum Peak Window Time (y):	7.8103E+02

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m^{**3}): 8.930E-08
Time of Peak (y): 5.7638E+02
Concentrations Averaged Between: 5.6138E+02 and 5.9138E+02 years

Average Concentration (mg/m**3): 8.926E-08
Maximum Dose: 7.899E-09
Maximum Allowable Inventory (mg): 1.266E+08

Contaminant Data

Contaminant Name: 4-meth

Half Life (y): 1.000E+12
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 0.000E+00
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 9.990E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 0.000E+00
Kd Aquifer (ml/g): 0.000E+00
Risk/Dose Conversion Factor: 9.999E-01

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3): 6.0514E-03
Solubility Limited Mass (mg): 1.6525E+11
Unsaturated Retardation Factor: 1.0000E+00
Mean Unsaturated Transit Time (y): 5.6903E+02
Leading Edge Arrival Time (y): 4.4500E+01
Aquifer Retardation Factor: 1.000E+00
Minimum Peak Window Time (y): 4.4601E+01
Maximum Peak Window Time (y): 6.9424E+02

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
Peak Concentration (mg/m**3): 1.004E-07
Time of Peak (y): 5.1272E+02
Concentrations Averaged Between: 4.9772E+02 and 5.2772E+02 years
Average Concentration (mg/m**3): 1.003E-07
Maximum Dose: 1.003E-07
Maximum Allowable Inventory (mg): 9.967E+06

Contaminant Data

Contaminant Name: tol

Half Life (y): 1.000E+12
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 1.000E+00
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 9.990E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 1.000E+00
Kd Aquifer (ml/g): 4.000E-02
Risk/Dose Conversion Factor: 7.300E+03

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 9.2593E-03
Initial Pore Water Conc (Ci or mg/m**3): 1.0086E-03
Solubility Limited Mass (mg): 9.9150E+11
Unsaturated Retardation Factor: 5.7687E+00
Mean Unsaturated Transit Time (y): 3.2826E+03
Leading Edge Arrival Time (y): 2.5671E+02
Aquifer Retardation Factor: 2.661E+00
Minimum Peak Window Time (y): 2.5698E+02
Maximum Peak Window Time (y): 4.0323E+03

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
Peak Concentration (mg/m**3): 1.740E-08
Time of Peak (y): 2.9612E+03
Concentrations Averaged Between: 2.9462E+03 and 2.9762E+03 years
Average Concentration (mg/m**3): 1.740E-08
Maximum Dose: 2.383E-12
Maximum Allowable Inventory (mg): 4.197E+11

Contaminant Data

Contaminant Name: mp-xyl

Half Life (y): 1.000E+12
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 3.000E+00
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 9.990E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 3.000E+00
Kd Aquifer (ml/g): 1.200E-01
Risk/Dose Conversion Factor: 7.300E+04

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 3.4722E-03
Initial Pore Water Conc (Ci or mg/m**3): 3.7821E-04
Solubility Limited Mass (mg): 2.6440E+12
Unsaturated Retardation Factor: 1.5306E+01
Mean Unsaturated Transit Time (y): 8.7096E+03
Leading Edge Arrival Time (y): 6.8112E+02
Aquifer Retardation Factor: 5.982E+00
Minimum Peak Window Time (y): 6.8173E+02
Maximum Peak Window Time (y): 1.0708E+04

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m3): 6.556E-09**
Time of Peak (y): 7.8583E+03
Concentrations Averaged Between: 7.8433E+03 and 7.8733E+03 years
Average Concentration (mg/m3): 6.556E-09**
Maximum Dose: 8.981E-14
Maximum Allowable Inventory (mg): 1.113E+13
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT

Contaminant Data

Contaminant Name: o-xyl
Half Life (y): 1.000E+12
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 0.000E+00
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 9.990E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 0.000E+00
Kd Aquifer (ml/g): 0.000E+00
Risk/Dose Conversion Factor: 7.300E+04

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3): 6.0514E-03
Solubility Limited Mass (mg): 1.6525E+11
Unsaturated Retardation Factor: 1.0000E+00
Mean Unsaturated Transit Time (y): 5.6903E+02
Leading Edge Arrival Time (y): 4.4500E+01
Aquifer Retardation Factor: 1.000E+00
Minimum Peak Window Time (y): 4.4601E+01
Maximum Peak Window Time (y): 6.9424E+02

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m3): 1.004E-07**
Time of Peak (y): 5.1272E+02
Concentrations Averaged Between: 4.9772E+02 and 5.2772E+02 years
Average Concentration (mg/m3): 1.003E-07**
Maximum Dose: 1.374E-12
Maximum Allowable Inventory (mg): 7.277E+11
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT

Contaminant Data

Contaminant Name: sty
Half Life (y): 1.000E+12
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 0.000E+00

Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 9.990E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 0.000E+00
Kd Aquifer (ml/g): 0.000E+00
Risk/Dose Conversion Factor: 7.300E+03

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3): 6.0514E-03
Solubility Limited Mass (mg): 1.6525E+11
Unsaturated Retardation Factor: 1.0000E+00
Mean Unsaturated Transit Time (y): 5.6903E+02
Leading Edge Arrival Time (y): 4.4500E+01
Aquifer Retardation Factor: 1.000E+00
Minimum Peak Window Time (y): 4.4601E+01
Maximum Peak Window Time (y): 6.9424E+02

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m**3): 1.004E-07
Time of Peak (y): 5.1272E+02
Concentrations Averaged Between: 4.9772E+02 and 5.2772E+02 years
Average Concentration (mg/m**3): 1.003E-07
Maximum Dose: 1.374E-11
Maximum Allowable Inventory (mg): 7.277E+10
Execution Time (Seconds): 1

GWSCREEN Input Deck – Non-Radionuclides Set #2

```
Nonrad 2 - CPP-603 - based on assumptions of ICDF CA modeling
4 3 3 1 1                               (Card 2) imode,itype,idisp,kflag,idil
1 1 2 1 2                               (Card 3) imodel,isolve,isolveu,imoist,imoistu
6 15 0.01                                (Card 4) jstart jmax eps
70. 2.555E+04 2.0 350. 30. 1.0          (Card 5) bw,at,wi,ef,ed,dlim
0. 0.                                     (Card 6) x0,y0
42.9 21.4 0.010                         (Card 7) l,w,perc
0.6 1.5                                  (Card 8b) thick, rhos, (source term values)
0.30                                     (Card 8c) thetas (source term mc)
22.7 1.359 2.92                         (Card 9) depth,rhou,axu

$ NOTE: The values of depth and axu are the ucode calibrated values
$ van Genuchten parameters from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
1.066 1.523 21.13 0.487 0.142           (Card 9b) alphau nu ksatu porsu thetaru
$use calib values for ax and az ay=0.2ax and az=1.16e-3ax as stated in the MEPAS Manual
3.31 0.2 1.163E-3 76. 15.                (Card 10) ax,ay,az,b,z(well screen thickness)
$ Aqui dens and porosity from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
$ --- Darcy velocity based on an assumed pore vel of ~ 1 m/d in EDF-ER-275
21.9 0.06 2.491                          (Card 11) u,phi,rhoa
1                                         (Card 12a) nrecept
121.45 0.                                (Card 12b x y)
15                                         (Card 12) ncontam

$ ----- Aluminum ----- 1
0 250. 250. 999 1.0 1.0E6 0.0          (card14a) nprog kds kdu zmw qi rmi sl other
'alumi' 1.e12 10. 3.65e4                (card14b) cname thalf kda dcf

$ ----- Arsenic----- 1
0 3. 3. 999 1.0 1.0E6 0.0              (card14a) nprog kds kdu zmw qi rmi sl other
'arsen' 1.e12 0.12 5.67e-2            (card14b) cname thalf kda dcf

$ ----- barium----- 1
0 50. 50. 999 1.0 1.0E6 0.0          (card14a) nprog kds kdu zmw qi rmi sl other
'bar' 1.e12 2. 2.56e+03             (card14b) cname thalf kda dcf

$ ----- beryllium----- 1
0 250. 250. 999 1.0 1.0E6 0.0          (card14a) nprog kds kdu zmw qi rmi sl other
'beryl' 1.e12 10. 1.98E-02            (card14b) cname thalf kda dcf

$ ----- cadmium----- 1
0 23. 6. 999 1.0 1.0E6 0.0            (card14a) nprog kds kdu zmw qi rmi sl other
'cadmi' 1.e12 0.24 3.65E+01          (card14b) cname thalf kda dcf

$ ----- chloride----- 1
0 1. 0. 999 1.0 1.0E6 0.0            (card14a) nprog kds kdu zmw qi rmi sl other
'chlor' 1.e12 0. 2.5E+05             (card14b) cname thalf kda dcf

$ ----- chromium----- 1
0 1.2 1.2 999 1.0 1.0E6 0.0          (card14a) nprog kds kdu zmw qi rmi sl other
'chrom' 1.e12 0.048 1.83E+02         (card14b) cname thalf kda dcf

$ ----- lead ----- 1
0 100. 100. 999 1.0 1.0E6 0.0          (card14a) nprog kds kdu zmw qi rmi sl other
'lead' 1.e12 4. 1.5E+01                (card14b) cname thalf kda dcf

$ ----- mercury----- 1
0 60. 100. 999 1.0 1.0E6 0.0          (card14a) nprog kds kdu zmw qi rmi sl other
'mercu' 1.e12 4. 3.65                 (card14b) cname thalf kda dcf

$ ----- nickel ----- 1
0 100. 100. 999 1.0 1.0E6 0.0          (card14a) nprog kds kdu zmw qi rmi sl other
'nicke' 1.e12 4. 7.3E+02              (card14b) cname thalf kda dcf

$ ----- selenium----- 1
0 4. 4. 999 1.0 1.0E6 0.0            (card14a) nprog kds kdu zmw qi rmi sl other
'selen' 1.e12 0.16 1.83E+02          (card14b) cname thalf kda dcf

$ ----- silicon----- 1
0 0. 0. 999 1.0 1.0E6 0.0            (card14a) nprog kds kdu zmw qi rmi sl other
'silic' 1.e12 0. 0.99999             (card14b) cname thalf kda dcf

$ ----- silver----- 1
0 90. 90. 999 1.0 1.0E6 0.0          (card14a) nprog kds kdu zmw qi rmi sl other
'silve' 1.e12 3.6 1.83E+02          (card14b) cname thalf kda dcf

$ ----- uranium----- 1
0 2500. 6. 999 1.0 1.0E6 0.0          (card14a) nprog kds kdu zmw qi rmi sl other
'urani' 1.e12 0.24 1.1E+02          (card14b) cname thalf kda dcf

$ ----- zinc ----- 1
0 16. 16. 999 1.0 1.0E6 0.0          (card14a) nprog kds kdu zmw qi rmi sl other
'zinc' 1.e12 0.64 1.1E+04            (card14b) cname thalf kda dcf
```

GWSCREEN Output – Non-Radionuclides Set #2

TIME OF RUN: 17:55:21.96 DATE OF RUN: 03/30/03

```
*****
* This output was produced by the model:
* GWSCREEN
* Version 2.5a
* A semi-analytical model for the assessment
* of the groundwater pathway from the leaching
* of surficial and buried contamination and
* release of contaminants from percolation ponds
* 07/16/2002
* Arthur S. Rood
* Idaho National Engineering and
* Environmental Laboratory
* PO Box 1625
* Idaho Falls, Idaho 83415
*****
```

ACKNOWLEDGEMENT OF GOVERNMENT SPONSORSHIP AND LIMITATION OF LIABILITY

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OUTPUT FILE NAME:

unit_nr2.out

INPUT FILE NAME:

unit_nr2.par

Title: Nonrad 2 - CPP-603 - based on assumptions of ICDF CA modeling

Model Run Options

IMODE Contaminant Type and Impacts:	4
ITYPE (1) Vert Avg (2) 3D Point (3) 3d Avg:	3
IDISP (0) Fixed Dispersivity (1-3) Spatially Varying:	3
KFLAG (1) Max Conc (2) Conc vs Time (3) Grid Output:	1
IDIL (1) No dilution factor (2) Include Dilution Factor:	1
IMOIST Source Moisture Content Option:	1
IMOISTU Unsaturated Moisture Content Option:	2
IMODEL (1) Surface/Burried Src (2) Pond (3) Usr Def:	1
ISOLVE (1) Gaussian Quarature (2) Simpsons Rule: (Aquifer)	1
ISOLVEU (1) Gaussian Quarature (2) Simpsons Rule: (Unsat Zone)	2

JSTART: 6

JMAX : 15

EPS : 1.000E-02

Health Effects: Ratio of groundwater concentration to MCL

Output mass/activity units: mg

Output concentration units: mg/m***3

Dose/Risk Conversion Units: mg/m***3

Output health effects units: Ratio of Cp/Cmcl

Cp = Peak groundwater concentration, Cmcl = Maximum contaminant limit

Exposure Parameters

Body Mass (kg):	70.	Averaging Time (days):	25550.
Water Ingestion (L/d):	2.000E+00	Exposure Freq (day/year):	3.500E+02
Exposure Duration (y):	3.000E+01	Limiting Dose:	1.000E+00

Site Parameters

X Coordinate:	0.000E+00	Y Coordinate:	0.000E+00
Source Length (m):	4.290E+01	Source Width (m):	2.140E+01
Percolation Rate (m/y):	1.000E-02		

Source Thickness (m): 6.000E-01 Src Bulk Density (g/cc): 1.500E+00
Source Moisture Content: 3.000E-01

Unsaturated Zone Parameters

Unsat Zone Thickness (m): 2.270E+01 Unsat Bulk Density: 1.359E+00
Unsat Alpha (1/m): 1.066E+00 Unsat n: 1.523E+00
Saturated K in Unsat (m/y): 2.113E+01 Porosity of Unsat Zone: 4.870E-01
Unsat Residual Moisture: 1.420E-01 Unsat Dispersivity (m): 2.920E+00

Aquifer Zone Parameters

Transverse/Longitud Ratio: 2.000E-01 Vertical/Longitud Ratio: 1.163E-03
Aquifer Thickness (m): 7.600E+01 Well Screen Thickness (m): 1.500E+01
Darcy Velocity (m/y): 2.190E+01 Aquifer Porosity: 6.000E-02
Bulk Density (g/cc): 2.491E+00

Calculated Flow Parameters

Percolation Water Flux (m³/y): 9.1806E+00
Unsaturated Moisture Content: 2.8499E-01
Unsat Pore Velocity (m/y): 3.5089E-02
Aquifer Pore Velocity (m/y): 3.6500E+02

Contaminant Data

Contaminant Name:	alumi
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	2.500E+02
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	2.500E+02
Kd Aquifer (ml/g):	1.000E+01
Risk/Dose Conversion Factor:	3.650E+04

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 4.4409E-05
Initial Pore Water Conc (Ci or mg/m³): 4.8373E-06
Solubility Limited Mass (mg): 2.0673E+14
Unsaturated Retardation Factor: 1.1932E+03
Mean Unsaturated Transit Time (y): 6.7895E+05
Leading Edge Arrival Time (y): 5.3096E+04
Aquifer Retardation Factor: 4.162E+02
Minimum Peak Window Time (y): 5.3138E+04
Maximum Peak Window Time (y): 8.3521E+05

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m³): 8.410E-11
Time of Peak (y): 6.1264E+05
Concentrations Averaged Between: 6.1263E+05 and 6.1266E+05 years
Average Concentration (mg/m³): 8.410E-11
Maximum Dose: 2.304E-15
Maximum Allowable Inventory (mg): 4.340E+14
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY
EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT

Contaminant Data

Contaminant Name:	arsen
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	3.000E+00
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	3.000E+00
Kd Aquifer (ml/g):	1.200E-01
Risk/Dose Conversion Factor:	5.670E-02

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 3.4722E-03

Initial Pore Water Conc (Ci or mg/m**3): 3.7821E-04
Solubility Limited Mass (mg): 2.6440E+12
Unsaturated Retardation Factor: 1.5306E+01
Mean Unsaturated Transit Time (y): 8.7096E+03
Leading Edge Arrival Time (y): 6.8112E+02
Aquifer Retardation Factor: 5.982E+00
Minimum Peak Window Time (y): 6.8173E+02
Maximum Peak Window Time (y): 1.0708E+04

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
Peak Concentration (mg/m**3): 6.556E-09
Time of Peak (y): 7.8583E+03
Concentrations Averaged Between: 7.8433E+03 and 7.8733E+03 years
Average Concentration (mg/m**3): 6.556E-09
Maximum Dose: 1.156E-07
Maximum Allowable Inventory (mg): 8.649E+06

Contaminant Data

Contaminant Name:	bar
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	5.000E+01
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	5.000E+01
Kd Aquifer (ml/g):	2.000E+00
Risk/Dose Conversion Factor:	2.560E+03

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 2.2134E-04
Initial Pore Water Conc (Ci or mg/m**3): 2.4109E-05
Solubility Limited Mass (mg): 4.11478E+13
Unsaturated Retardation Factor: 2.3943E+02
Mean Unsaturated Transit Time (y): 1.3625E+05
Leading Edge Arrival Time (y): 1.0655E+04
Aquifer Retardation Factor: 8.403E+01
Minimum Peak Window Time (y): 1.0663E+04
Maximum Peak Window Time (y): 1.6760E+05

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
Peak Concentration (mg/m**3): 4.191E-10
Time of Peak (y): 1.2294E+05
Concentrations Averaged Between: 1.2292E+05 and 1.2295E+05 years
Average Concentration (mg/m**3): 4.191E-10
Maximum Dose: 1.637E-13
Maximum Allowable Inventory (mg): 6.108E+12

Contaminant Data

Contaminant Name:	beryl
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	2.500E+02
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	2.500E+02
Kd Aquifer (ml/g):	1.000E+01
Risk/Dose Conversion Factor:	1.980E-02

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 4.4409E-05
Initial Pore Water Conc (Ci or mg/m**3): 4.8373E-06
Solubility Limited Mass (mg): 2.0673E+14
Unsaturated Retardation Factor: 1.1932E+03
Mean Unsaturated Transit Time (y): 6.7895E+05
Leading Edge Arrival Time (y): 5.3096E+04
Aquifer Retardation Factor: 4.162E+02
Minimum Peak Window Time (y): 5.3138E+04
Maximum Peak Window Time (y): 8.3521E+05

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m³*3): 8.410E-11
Time of Peak (y): 6.1264E+05
Concentrations Averaged Between: 6.1263E+05 and 6.1266E+05 years
Average Concentration (mg/m³*3): 8.410E-11
Maximum Dose: 4.247E-09
Maximum Allowable Inventory (mg): 2.354E+08

Contaminant Data

Contaminant Name:	cadmi
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	2.300E+01
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	6.000E+00
Kd Aquifer (ml/g):	2.400E-01
Risk/Dose Conversion Factor:	3.650E+01

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 4.7893E-04
Initial Pore Water Conc (Ci or mg/m³*3): 5.2167E-05
Solubility Limited Mass (mg): 1.9169E+13
Unsaturated Retardation Factor: 2.9612E+01
Mean Unsaturated Transit Time (y): 1.6850E+04
Leading Edge Arrival Time (y): 1.3177E+03
Aquifer Retardation Factor: 1.096E+01
Minimum Peak Window Time (y): 1.3188E+03
Maximum Peak Window Time (y): 3.1328E+04

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m³*3): 3.255E-09
Time of Peak (y): 1.7008E+04
Concentrations Averaged Between: 1.6993E+04 and 1.7023E+04 years
Average Concentration (mg/m³*3): 3.255E-09
Maximum Dose: 8.917E-11
Maximum Allowable Inventory (mg): 1.121E+10

Contaminant Data

Contaminant Name:	chlor
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	1.000E+00
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	0.000E+00
Kd Aquifer (ml/g):	0.000E+00
Risk/Dose Conversion Factor:	2.500E+05

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 9.2593E-03
Initial Pore Water Conc (Ci or mg/m³*3): 1.0086E-03
Solubility Limited Mass (mg): 9.9150E+11
Unsaturated Retardation Factor: 1.0000E+00
Mean Unsaturated Transit Time (y): 5.6903E+02
Leading Edge Arrival Time (y): 4.4500E+01
Aquifer Retardation Factor: 1.000E+00
Minimum Peak Window Time (y): 4.4601E+01
Maximum Peak Window Time (y): 1.3181E+03

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (mg/m³*3): 9.194E-08
Time of Peak (y): 6.1511E+02
Concentrations Averaged Between: 6.0011E+02 and 6.3011E+02 years

Average Concentration (mg/m**3): 9.190E-08
Maximum Dose: 3.676E-13
Maximum Allowable Inventory (mg): 2.720E+12
WARNING: PORE WATER CONCENTRATION OF THE MAXIMUM ALLOWABLE INVENTORY EXCEEDS THE SOLUBILITY LIMIT OF THE CONTAMINANT

Contaminant Data

Contaminant Name:	chrom
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	1.200E+00
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	1.200E+00
Kd Aquifer (ml/g):	4.800E-02
Risk/Dose Conversion Factor:	1.830E+02

Calculated Contaminant Values

Decay Constants (1/y):	6.9315E-13
Leach Rate Constant (1/y):	7.9365E-03
Initial Pore Water Conc (Ci or mg/m**3):	8.6449E-04
Solubility Limited Mass (mg):	1.1568E+12
Unsaturated Retardation Factor:	6.7224E+00
Mean Unsaturated Transit Time (y):	3.8253E+03
Leading Edge Arrival Time (y):	2.9915E+02
Aquifer Retardation Factor:	2.993E+00
Minimum Peak Window Time (y):	2.9945E+02
Maximum Peak Window Time (y):	4.6999E+03

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y):	1.7840E+03	Y Dispersion Coeff (m2/y):	3.5680E+02
Peak Concentration (mg/m**3):	1.493E-08		
Time of Peak (y):	3.4509E+03		
Concentrations Averaged Between:	3.4359E+03	and	3.4659E+03 years
Average Concentration (mg/m**3):	1.493E-08		
Maximum Dose:	8.157E-11		
Maximum Allowable Inventory (mg):	1.226E+10		

Contaminant Data

Contaminant Name:	lead
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	1.000E+02
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	1.000E+02
Kd Aquifer (ml/g):	4.000E+00
Risk/Dose Conversion Factor:	1.500E+01

Calculated Contaminant Values

Decay Constants (1/y):	6.9315E-13
Leach Rate Constant (1/y):	1.1089E-04
Initial Pore Water Conc (Ci or mg/m**3):	1.2079E-05
Solubility Limited Mass (mg):	8.2791E+13
Unsaturated Retardation Factor:	4.7787E+02
Mean Unsaturated Transit Time (y):	2.7192E+05
Leading Edge Arrival Time (y):	2.1265E+04
Aquifer Retardation Factor:	1.671E+02
Minimum Peak Window Time (y):	2.1282E+04
Maximum Peak Window Time (y):	3.3450E+05

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y):	1.7840E+03	Y Dispersion Coeff (m2/y):	3.5680E+02
Peak Concentration (mg/m**3):	2.100E-10		
Time of Peak (y):	2.4536E+05		
Concentrations Averaged Between:	2.4535E+05	and	2.4538E+05 years
Average Concentration (mg/m**3):	2.100E-10		
Maximum Dose:	1.400E-11		
Maximum Allowable Inventory (mg):	7.143E+10		

Contaminant Data

Contaminant Name:	mercu
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	6.000E+01
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	1.000E+02
Kd Aquifer (ml/g):	4.000E+00
Risk/Dose Conversion Factor:	3.650E+00
Calculated Contaminant Values	
Decay Constants (1/y):	6.9315E-13
Leach Rate Constant (1/y):	1.8457E-04
Initial Pore Water Conc (Ci or mg/m**3):	2.0104E-05
Solubility Limited Mass (mg):	4.9740E+13
Unsaturated Retardation Factor:	4.7787E+02
Mean Unsaturated Transit Time (y):	2.7192E+05
Leading Edge Arrival Time (y):	2.1265E+04
Aquifer Retardation Factor:	1.671E+02
Minimum Peak Window Time (y):	2.1282E+04
Maximum Peak Window Time (y):	3.0955E+05
Results for Receptor X = 1.21450E+02 Y = 0.00000E+00	
X Dispersion Coeff (m2/y):	1.7840E+03
Y Dispersion Coeff (m2/y):	3.5680E+02
Peak Concentration (mg/m**3):	2.104E-10
Time of Peak (y):	2.4139E+05
Concentrations Averaged Between: 2.4137E+05 and 2.4140E+05 years	
Average Concentration (mg/m**3):	2.104E-10
Maximum Dose:	5.764E-11
Maximum Allowable Inventory (mg):	1.735E+10
Contaminant Data	
Contaminant Name:	nickle
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	1.000E+02
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	1.000E+02
Kd Aquifer (ml/g):	4.000E+00
Risk/Dose Conversion Factor:	7.300E+02
Calculated Contaminant Values	
Decay Constants (1/y):	6.9315E-13
Leach Rate Constant (1/y):	1.1089E-04
Initial Pore Water Conc (Ci or mg/m**3):	1.2079E-05
Solubility Limited Mass (mg):	8.2791E+13
Unsaturated Retardation Factor:	4.7787E+02
Mean Unsaturated Transit Time (y):	2.7192E+05
Leading Edge Arrival Time (y):	2.1265E+04
Aquifer Retardation Factor:	1.671E+02
Minimum Peak Window Time (y):	2.1282E+04
Maximum Peak Window Time (y):	3.3450E+05
Results for Receptor X = 1.21450E+02 Y = 0.00000E+00	
X Dispersion Coeff (m2/y):	1.7840E+03
Y Dispersion Coeff (m2/y):	3.5680E+02
Peak Concentration (mg/m**3):	2.100E-10
Time of Peak (y):	2.4536E+05
Concentrations Averaged Between: 2.4535E+05 and 2.4538E+05 years	
Average Concentration (mg/m**3):	2.100E-10
Maximum Dose:	2.876E-13
Maximum Allowable Inventory (mg):	3.476E+12
Contaminant Data	
Contaminant Name:	selen
Half Life (y):	1.000E+12
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	4.000E+00
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.990E+02

Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 4.000E+00
Kd Aquifer (ml/g): 1.600E-01
Risk/Dose Conversion Factor: 1.830E+02

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 2.6455E-03
Initial Pore Water Conc (Ci or mg/m**3): 2.8816E-04
Solubility Limited Mass (mg): 3.4703E+12
Unsaturated Retardation Factor: 2.0075E+01
Mean Unsaturated Transit Time (y): 1.1423E+04
Leading Edge Arrival Time (y): 8.9333E+02
Aquifer Retardation Factor: 7.643E+00
Minimum Peak Window Time (y): 8.9410E+02
Maximum Peak Window Time (y): 1.4047E+04

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
Peak Concentration (mg/m**3): 4.999E-09
Time of Peak (y): 1.0307E+04
Concentrations Averaged Between: 1.0292E+04 and 1.0322E+04 years
Average Concentration (mg/m**3): 4.999E-09
Maximum Dose: 2.731E-11
Maximum Allowable Inventory (mg): 3.661E+10

Contaminant Data

Contaminant Name: silic
Half Life (y): 1.000E+12
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 0.000E+00
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 9.990E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 0.000E+00
Kd Aquifer (ml/g): 0.000E+00
Risk/Dose Conversion Factor: 1.000E+00

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 5.5556E-02
Initial Pore Water Conc (Ci or mg/m**3): 6.0514E-03
Solubility Limited Mass (mg): 1.6525E+11
Unsaturated Retardation Factor: 1.0000E+00
Mean Unsaturated Transit Time (y): 5.6903E+02
Leading Edge Arrival Time (y): 4.4500E+01
Aquifer Retardation Factor: 1.000E+00
Minimum Peak Window Time (y): 4.4601E+01
Maximum Peak Window Time (y): 6.9424E+02

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
Peak Concentration (mg/m**3): 1.004E-07
Time of Peak (y): 5.1272E+02
Concentrations Averaged Between: 4.9772E+02 and 5.2772E+02 years
Average Concentration (mg/m**3): 1.003E-07
Maximum Dose: 1.003E-07
Maximum Allowable Inventory (mg): 9.968E+06

Contaminant Data

Contaminant Name: silve
Half Life (y): 1.000E+12
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 9.000E+01
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 9.990E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 9.000E+01
Kd Aquifer (ml/g): 3.600E+00
Risk/Dose Conversion Factor: 1.830E+02

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13

Leach Rate Constant (1/y): 1.2318E-04
Initial Pore Water Conc (Ci or mg/m**3): 1.3418E-05
Solubility Limited Mass (mg): 7.4528E+13
Unsaturated Retardation Factor: 4.3018E+02
Mean Unsaturated Transit Time (y): 2.4479E+05
Leading Edge Arrival Time (y): 1.9143E+04
Aquifer Retardation Factor: 1.505E+02
Minimum Peak Window Time (y): 1.9158E+04
Maximum Peak Window Time (y): 3.0112E+05

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
Peak Concentration (mg/m**3): 2.333E-10
Time of Peak (y): 2.2088E+05
Concentrations Averaged Between: 2.2086E+05 and 2.2089E+05 years
Average Concentration (mg/m**3): 2.333E-10
Maximum Dose: 1.275E-12
Maximum Allowable Inventory (mg): 7.845E+11

Contaminant Data

Contaminant Name: urani

Half Life (y): 1.000E+12
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 2.500E+03
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 9.990E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 6.000E+00
Kd Aquifer (ml/g): 2.400E-01
Risk/Dose Conversion Factor: 1.100E+02

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 4.4441E-06
Initial Pore Water Conc (Ci or mg/m**3): 4.8407E-07
Solubility Limited Mass (mg): 2.0658E+15
Unsaturated Retardation Factor: 2.9612E+01
Mean Unsaturated Transit Time (y): 1.6850E+04
Leading Edge Arrival Time (y): 1.3177E+03
Aquifer Retardation Factor: 1.096E+01
Minimum Peak Window Time (y): 1.3188E+03
Maximum Peak Window Time (y): 1.5766E+06

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
Peak Concentration (mg/m**3): 2.758E-10
Time of Peak (y): 4.6030E+04
Concentrations Averaged Between: 4.6015E+04 and 4.6045E+04 years
Average Concentration (mg/m**3): 2.758E-10
Maximum Dose: 2.507E-12
Maximum Allowable Inventory (mg): 3.989E+11

Contaminant Data

Contaminant Name: zinc

Half Life (y): 1.000E+12
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 1.600E+01
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 9.990E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 1.600E+01
Kd Aquifer (ml/g): 6.400E-01
Risk/Dose Conversion Factor: 1.100E+04

Calculated Contaminant Values

Decay Constants (1/y): 6.9315E-13
Leach Rate Constant (1/y): 6.8587E-04
Initial Pore Water Conc (Ci or mg/m**3): 7.4709E-05
Solubility Limited Mass (mg): 1.3385E+13
Unsaturated Retardation Factor: 7.7298E+01
Mean Unsaturated Transit Time (y): 4.3985E+04
Leading Edge Arrival Time (y): 3.4398E+03
Aquifer Retardation Factor: 2.757E+01

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Minimum Peak Window Time (y) : 3.4426E+03
Maximum Peak Window Time (y) : 5.4103E+04

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y) : 1.7840E+03 Y Dispersion Coeff (m²/y) : 3.5680E+02
Peak Concentration (mg/m^{**3}) : 1.298E-09
Time of Peak (y) : 3.9689E+04
Concentrations Averaged Between: 3.9674E+04 and 3.9704E+04 years
Average Concentration (mg/m^{**3}) : 1.298E-09
Maximum Dose: 1.180E-13
Maximum Allowable Inventory (mg) : 8.474E+12
Execution Time (Seconds) : 1

GWSCREEN Input Deck – Radionuclides

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RAD - CPP-603 - based on assumptions of ICDF CA modeling
2 3 3 1 1                               (Card 2) imode,itype,idisp,kflag,idil
1 1 2 1 2                               (Card 3) imodel,isolve,isolveu,imoist,imoistu
6 15 0.01                                (Card 4) jstart jmax eps
70. 2.555E+04 2.0 350. 30. 1.0E-6      (Card 5) bw,at,wi,ef,ed,dlim
0. 0.                                     (Card 6) x0,y0
42.9 21.4 0.010                         (Card 7) l,w,perc
0.6 1.5                                 (Card 8b) thick, rhos, (source term values)
0.30 .                                 (Card 8c) thetas (source term mc)
22.7 1.359 2.92                         (Card 9) depth,rhou,axu

$ NOTE: The values of depth and axu are the ucode calibrated values
$ van Genuchten parameters from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
1.066 1.523 21.13 0.487 0.142          (Card 9b) alphau nu ksatu porsu thetaru
$use calib values for ax and az ay=0.2ax and az=1.16e-3ax as stated in the MEPAS Manual
3.31 0.2 1.163E-3 76. 15.              (Card 10) ax,ay,az,b,z(well screen thickness)
$ Aqui dens and porosity from EDF-ER-275 60% Design Component Report Table 2-2 and 2-3
$ --- Darcy velocity based on an assumed pore vel of ~ 1 m/d in EDF-ER-275
21.9 0.06 2.491                         (Card 11) u,phi,rho
1                                     (Card 12a) nrecept
121.45 0.                                (Card 12b x y)
12                                (Card 14) ncontam

$ ----- Am-241 (Np) ----- 1
3 5000. 340. 237 1.00 0. 1.E+6 0.      (card14a) nprog kds kdu zmw qi rmi sl other
'Am-241' 432. 13.6 3.28E+02           (card14b) cname thalf kda dcf
'Np-237' 2.140E+06 0.32 3.00E+02      (card14b) cname thalf kda dcf
'U-233' 1.592E+05 0.24 4.48E+01      (card14b) cname thalf kda dcf
'Th-229' 7.340E+03 4 3.56E+02        (card14b) cname thalf kda dcf

$ ----- C-14 ----- 2
0 10. 0.1 14 1.00 0. 1.E+6 0.          (card14a) nprog kds kdu zmw qi rmi sl other
'C-14' 5.730E+03 0.004 1.03E+00       (card14b) cname thalf kda dcf

$ ----- I-129 ----- 3
0 2.0 0.1 129 1.00 0. 1.0E+06 0.      (card14a) nprog kds kdu zmw qi rmi sl other
'I-129' 1.570E+07 0.004 1.84E+02      (card14b) cname thalf kda dcf

$ ----- Nb-94 ----- 4
0 1000. 8. 94 1.00 0. 1.E+6 0.          (card14a) nprog kds kdu zmw qi rmi sl other
'Nb-94' 2.03E+04 0.32 6.91E+00        (card14b) cname thalf kda dcf

$ ----- Np-237 ----- 5
2 5000. 8. 237 1.00 0. 1.E+6 0.          (card14a) nprog kds kdu zmw qi rmi sl other
'Np-237' 2.140E+06 0.32 3.00E+02      (card14b) cname thalf kda dcf
'U-233' 1.592E+05 0.24 4.48E+01      (card14b) cname thalf kda dcf
'Th-229' 7.340E+03 4 3.56E+02        (card14b) cname thalf kda dcf

$ ----- Pu-238 ----- 6
4 5000. 140. 238. 1.00 1.0 1.0E6 0.0  (Card 12a) nprog kds kdu zmw q0 rmi sl other
Pu-238 87.8 5.6 2.95E+02               (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
U-234 2.45E5 0.24 4.44E+01            (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Th-230 7.54E4 4.0 3.75E+01            (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Ra-226 1.60E3 4.0 2.96E+02            (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Pb-210 22.3 4.0 1.01E+03              (Card 12b) cname(i),thalf(i),kda(i),dcf(i)

$ ----- Pu-239 ----- 5
3 5000. 140. 239 1.00 0. 1.E+6 0.      (card14a) nprog kds kdu zmw qi rmi sl other
'Pu-239' 2.410E+04 5.6 3.16E+02       (card14b) cname thalf kda dcf
'U-235' 7.037E+08 0.24 4.70E+01       (card14b) cname thalf kda dcf
'Pa-231' 3.276E+04 22 1.49E+02         (card14b) cname thalf kda dcf
'Ac-227' 2.177E+01 18 6.26E+02         (card14b) cname thalf kda dcf

$ ----- Pu-240 ----- 6
4 5000. 140. 240 1.00 0. 1.E+6 0.      (card14a) nprog kds kdu zmw qi rmi sl other
'Pu-240' 6.560E+03 5.6 3.15E+02       (card14b) cname thalf kda dcf
'U-236' 2.342E+07 0.24 4.21E+01       (card14b) cname thalf kda dcf
'Th-232' 1.410E+10 4 3.28E+01         (card14b) cname thalf kda dcf
'Ra-228' 5.750E+00 4 2.48E+02         (card14b) cname thalf kda dcf
'Th-228' 1.910E+00 4 2.31E+02         (card14b) cname thalf kda dcf

$ ----- Tc-99 ----- 7
0 1000. 0.2 99 1.00 0. 1.E+6 0.          (card14a) nprog kds kdu zmw qi rmi sl other
'Tc-99' 2.111E+05 0.008 1.40E+00       (card14b) cname thalf kda dcf

$ ----- U-234 ----- 8
3 2000. 6. 234 1.00 0. 1.E+6 0.          (card14a) nprog kds kdu zmw qi rmi sl other
'U-234' 2.45E+05 0.24 4.44E+01         (card14b) cname thalf kda dcf
'Th-230' 7.54E+04 4 3.75E+01           (card14b) cname thalf kda dcf
'Ra-226' 1.60E+03 4 2.96E+02           (card14b) cname thalf kda dcf
'Pb-210' 2.23E+01 4 1.01E+03           (card14b) cname thalf kda dcf

$ ----- U-235 ----- 9
2 2000. 6. 235. 1.00 1.0 1.0E6 0.0    (Card 12a) nprog kds kdu zmw q0 rmi sl other
U-235 7.04E8 0.24 4.70E+01             (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Pa-231 3.28E4 22.0 1.49E+02            (Card 12b) cname(i),thalf(i),kda(i),dcf(i)
Ac-227 21.8 18.0 6.26E+02              (Card 12b) cname(i),thalf(i),kda(i),dcf(i)

$ ----- U-238 ----- 9
4 2000. 6. 238 1.00 0. 1.E+6 0.          (card14a) nprog kds kdu zmw qi rmi sl other

```

'U-238'	4.470E+09	0.24	6.20E+01	(card14b) cname thalf kda dcf
'U-234'	2.45E+05	0.24	4.44E+01	(card14b) cname thalf kda dcf
'Th-230'	7.54E+04	4	3.75E+01	(card14b) cname thalf kda dcf
'Ra-226'	1.60E+03	4	2.96E+02	(card14b) cname thalf kda dcf
'Pb-210'	2.23E+01	4	1.01E+03	(card14b) cname thalf kda dcf

GWSCREEN Output – Radionuclides

TIME OF RUN: 16:44:21.88 DATE OF RUN: 03/30/03

```
*****
*      This output was produced by the model:      *
*      GWSCREEN                                     *
*          Version 2.5a                           *
*      A semi-analytical model for the assessment   *
*      of the groundwater pathway from the leaching  *
*      of surficial and buried contamination and   *
*      release of contaminants from percolation ponds*
*          07/16/2002                                *
*          Arthur S. Rood                         *
*          Idaho National Engineering and          *
*              Environmental Laboratory            *
*          PO Box 1625                            *
*          Idaho Falls, Idaho 83415               *
*****
```

ACKNOWLEDGEMENT OF GOVERNMENT SPONSORSHIP AND LIMITATION OF LIABILITY

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OUTPUT FILE NAME:

r-unit.out

INPUT FILE NAME:

r-unit.par

Title: RAD - CPP-603 - based on assumptions of ICDF CA modeling

Model Run Options

IMODE Contaminant Type and Impacts:	2
ITYPE (1) Vert Avg (2) 3D Point (3) 3d Avg:	3
IDISP (0) Fixed Dispersivity (1-3) Spatially Varying:	3
KFLAG (1) Max Conc (2) Conc vs Time (3) Grid Output:	1
IDIL (1) No dilution factor (2) Include Dilution Factor:	1
IMOIST Source Moisture Content Option:	1
IMOISTU Unsaturated Moisture Content Option:	2
IMODEL (1) Surface/Burried Src (2) Pond (3) Usr Def:	1
ISOLVE (1) Gaussian Quarature (2) Simpsons Rule: (Aquifer)	1
ISOLVEU (1) Gaussian Quarature (2) Simpsons Rule: (Unsat Zone)	2

JSTART: 6

JMAX : 15

EPS : 1.000E-02

Health Effects: Carcinogenic incidence risk for radionuclides

Output mass/activity units: Ci

Output concentration units: Ci/m**3

Dose/Risk Conversion Units: 1/Ci

Output health effects units: carcinogenic risk

Exposure Parameters

Body Mass (kg):	70.	Averaging Time (days):	25550.
Water Ingestion (L/d):	2.000E+00	Exposure Freq (day/year):	3.500E+02
Exposure Duration (y):	3.000E+01	Limiting Dose:	1.000E-06

Site Parameters

X Coordinate:	0.000E+00	Y Coordinate:	0.000E+00
Source Length (m):	4.290E+01	Source Width (m):	2.140E+01
Percolation Rate (m/y):	1.000E-02	Src Bulk Density (g/cc):	1.500E+00
Source Thickness (m):	6.000E-01		

Source Moisture Content: 3.000E-01

Unsaturated Zone Parameters

Unsat Zone Thickness (m):	2.270E+01	Unsat Bulk Density:	1.359E+00
Unsat Alpha (1/m):	1.066E+00	Unsat n:	1.523E+00
Saturated K in Unsat (m/y):	2.113E+01	Porosity of Unsat Zone:	4.870E-01
Unsat Residual Moisture:	1.420E-01	Unsat Dispersivity (m):	2.920E+00

Aquifer Zone Parameters

Transverse/Longitud Ratio:	2.000E-01	Vertical/Longitud Ratio:	1.163E-03
Aquifer Thickness (m):	7.600E+01	Well Screen Thickness (m):	1.500E+01
Darcy Velocity (m/y):	2.190E+01	Aquifer Porosity:	6.000E-02
Bulk Density (g/cc):	2.491E+00		

Calculated Flow Parameters

Percolation Water Flux (m ³ /y):	9.1806E+00
Unsaturated Moisture Content:	2.8499E-01
Unsat Pore Velocity (m/y):	3.5089E-02
Aquifer Pore Velocity (m/y):	3.6500E+02
Root not bracketed in subroutine UTT	

Contaminant Data

Contaminant Name: Am-241

Number of Progeny:	3
Progeny Names:	Np-237 U-233 Th-229
Half Life (y):	4.320E+02 2.140E+06 1.592E+05 7.340E+03
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	5.000E+03
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	2.370E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	3.400E+02
Kd Aquifer (ml/g):	1.360E+01 3.200E-01 2.400E-01 4.000E+00
Risk/Dose Conversion Factor:	3.280E+02 3.000E+02 4.480E+01 3.560E+02

Calculated Contaminant Values

Decay Constants (1/y):	1.6045E-03 3.2390E-07 4.3539E-06 9.4434E-05
Leach Rate Constant (1/y):	2.2221E-06
Initial Pore Water Conc (Ci or mg/m**3):	2.4205E-07
Solubility Limited Mass (mg):	4.1314E+15
Solubility Limited Act (Ci):	1.4438E+13
Unsaturated Retardation Factor:	1.6223E+03
Mean Unsaturated Transit Time (y):	3.5479E+04
Leading Edge Arrival Time (y):	3.5479E+04
Aquifer Retardation Factor:	5.656E+02 1.429E+01 1.096E+01 1.671E+02
Minimum Peak Window Time (y):	3.5535E+04
Maximum Peak Window Time (y):	3.1550E+06

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02

NOTE: Concentrations and Doses Reported in Order of the Decay Chain

NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration

Peak Concentration (Ci/m**3): 0.000E+00 0.000E+00 0.000E+00 0.000E+00

Time of Peak (y): 3.1550E+06

Concentrations Averaged Between: 3.1550E+06 and 3.1550E+06 years

Average Concentration (Ci/m**3): 0.000E+00 0.000E+00 0.000E+00 0.000E+00

Maximum Dose: 0.000E+00 0.000E+00 0.000E+00 0.000E+00

Total Dose (all members): 0.000E+00

Maximum allowable inventory is infinite

Contaminant Data

Contaminant Name: C-14

Number of Progeny:	0
Half Life (y):	5.730E+03
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	1.000E+01
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	1.400E+01
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	1.000E-01
Kd Aquifer (ml/g):	4.000E-03
Risk/Dose Conversion Factor:	1.030E+00

Calculated Contaminant Values

Decay Constants (1/y): 1.2097E-04
Leach Rate Constant (1/y): 1.0893E-03
Initial Pore Water Conc (Ci or mg/m**3): 1.1866E-04
Solubility Limited Mass (mg): 8.4278E+12
Solubility Limited Act (Ci): 3.7589E+10
Unsaturated Retardation Factor: 1.4769E+00
Mean Unsaturated Transit Time (y): 8.1943E+02
Leading Edge Arrival Time (y): 6.5721E+01
Aquifer Retardation Factor: 1.166E+00
Minimum Peak Window Time (y): 6.5839E+01
Maximum Peak Window Time (y): 7.1830E+03

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
Peak Concentration (Ci/m3): 2.985E-08**
Time of Peak (y): 1.2685E+03
Concentrations Averaged Between: 1.2535E+03 and 1.2835E+03 years
Average Concentration (Ci/m3): 2.985E-08**
Maximum Dose: 6.456E-07
Maximum Allowable Inventory (Ci): 1.549E+00

Contaminant Data

Contaminant Name:	I-129
Number of Progeny:	0
Half Life (y):	1.570E+07
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	2.000E+00
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	1.290E+02
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	1.000E-01
Kd Aquifer (ml/g):	4.000E-03
Risk/Dose Conversion Factor:	1.840E+02

Calculated Contaminant Values

Decay Constants (1/y): 4.4150E-08
Leach Rate Constant (1/y): 5.0505E-03
Initial Pore Water Conc (Ci or mg/m**3): 5.5013E-04
Solubility Limited Mass (mg): 1.8178E+12
Solubility Limited Act (Ci): 3.2113E+05
Unsaturated Retardation Factor: 1.4769E+00
Mean Unsaturated Transit Time (y): 8.4038E+02
Leading Edge Arrival Time (y): 6.5721E+01
Aquifer Retardation Factor: 1.166E+00
Minimum Peak Window Time (y): 6.5839E+01
Maximum Peak Window Time (y): 2.2133E+03

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
Peak Concentration (Ci/m3): 6.008E-08**
Time of Peak (y): 9.4546E+02
Concentrations Averaged Between: 9.3046E+02 and 9.6046E+02 years
Average Concentration (Ci/m3): 6.007E-08**
Maximum Dose: 2.321E-04
Maximum Allowable Inventory (Ci): 4.309E-03

Contaminant Data

Contaminant Name:	Nb-94
Number of Progeny:	0
Half Life (y):	2.030E+04
Other Source Loss Rate (1/y):	0.000E+00
Kd Source (ml/g):	1.000E+03
Solubility Limit (mg/L):	1.000E+06
Molecular Weight (mg/L):	9.400E+01
Initial mass/activity:	1.000E+00
Kd Unsat (ml/g):	8.000E+00
Kd Aquifer (ml/g):	3.200E-01
Risk/Dose Conversion Factor:	6.910E+00

Calculated Contaminant Values

Decay Constants (1/y): 3.4145E-05

Leach Rate Constant (1/y): 1.1109E-05
Initial Pore Water Conc (Ci or mg/m**3): 1.2100E-06
Solubility Limited Mass (mg): 8.2642E+14
Solubility Limited Act (Ci): 1.5496E+11
Unsaturated Retardation Factor: 3.9149E+01
Mean Unsaturated Transit Time (y): 1.8935E+04
Leading Edge Arrival Time (y): 1.7422E+03
Aquifer Retardation Factor: 1.429E+01
Minimum Peak Window Time (y): 1.7436E+03
Maximum Peak Window Time (y): 6.4290E+05

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
Peak Concentration (Ci/m3): 1.625E-10**
Time of Peak (y): 2.9709E+04
Concentrations Averaged Between: 2.9694E+04 and 2.9724E+04 years
Average Concentration (Ci/m3): 1.625E-10**
Maximum Dose: 2.358E-08
Maximum Allowable Inventory (Ci): 4.241E+01

Contaminant Data

Contaminant Name: Np-237

Number of Progeny: 2
Progeny Names: U-233 Th-229
Half Life (y): 2.140E+06 1.590E+05 7.340E+03
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 5.000E+03
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 2.370E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 8.000E+00
Kd Aquifer (ml/g): 3.200E-01 2.400E-01 4.000E+00
Risk/Dose Conversion Factor: 3.000E+02 4.480E+01 3.560E+02

Calculated Contaminant Values

Decay Constants (1/y): 3.2390E-07 4.3594E-06 9.4434E-05
Leach Rate Constant (1/y): 2.2221E-06
Initial Pore Water Conc (Ci or mg/m**3): 2.4205E-07
Solubility Limited Mass (mg): 4.1314E+15
Solubility Limited Act (Ci): 2.9145E+09
Unsaturated Retardation Factor: 3.9149E+01
Mean Unsaturated Transit Time (y): 2.2236E+04
Leading Edge Arrival Time (y): 1.7422E+03
Aquifer Retardation Factor: 1.429E+01 1.096E+01 1.671E+02
Minimum Peak Window Time (y): 1.7436E+03
Maximum Peak Window Time (y): 3.1415E+06

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02

NOTE: Concentrations and Doses Reported in Order of the Decay Chain

NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration

Peak Concentration (Ci/m3): 1.406E-10 4.502E-11 2.515E-12**
Time of Peak (y): 6.3950E+04
Concentrations Averaged Between: 6.3935E+04 and 6.3965E+04 years
Average Concentration (Ci/m3): 1.406E-10 4.502E-11 2.515E-12**
Maximum Dose: 8.860E-07 4.236E-08 1.880E-08
Total Dose (all members): 9.471E-07
Maximum Allowable Inventory (Ci): 1.056E+00

Root not bracketed in subroutine UTT

Contaminant Data

Contaminant Name: Pu-238

Number of Progeny: 4
Progeny Names: U-234 Th-230 Ra-226 Pb-210
Half Life (y): 8.780E+01 2.450E+05 7.540E+04 1.600E+03 2.230E+01
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 5.000E+03
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 2.380E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 1.400E+02
Kd Aquifer (ml/g): 8.800E-01 2.400E-01 4.000E+00 4.000E+00 4.000E+00
Risk/Dose Conversion Factor: 2.950E+02 4.440E+01 3.750E+01 2.960E+02 1.010E+03

Calculated Contaminant Values

Decay Constants (1/y): 7.8946E-03 2.8292E-06 9.1929E-06 4.3322E-04 3.1083E-02
Leach Rate Constant (1/y): 2.2221E-06
Initial Pore Water Conc (Ci or mg/m**3): 2.4205E-07
Solubility Limited Mass (mg): 4.1314E+15
Solubility Limited Act (Ci): 7.0739E+13
Unsaturated Retardation Factor: 6.6861E+02
Mean Unsaturated Transit Time (y): 1.0284E+04
Leading Edge Arrival Time (y): 1.0284E+04
Aquifer Retardation Factor: 3.753E+01 1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y): 1.0288E+04
Maximum Peak Window Time (y): 3.1296E+06

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
NOTE: Concentrations and Doses Reported in Order of the Decay Chain
NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3): 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00
Time of Peak (y): 3.1296E+06
Concentrations Averaged Between: 3.1295E+06 and 3.1296E+06 years
Average Concentration (Ci/m**3): 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00
Maximum Dose: 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00
Total Dose (all members): 0.000E+00
Maximum allowable inventory is infinite

Contaminant Data

Contaminant Name: Pu-239

Number of Progeny: 3
Progeny Names: U-235 Pa-231 Ac-227
Half Life (y): 2.410E+04 7.037E+08 3.276E+04 2.177E+01
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 5.000E+03
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 2.390E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 1.400E+02
Kd Aquifer (ml/g): 5.600E+00 2.400E-01 2.200E+01 1.800E+01
Risk/Dose Conversion Factor: 3.160E+02 4.700E+01 1.490E+02 6.260E+02

Calculated Contaminant Values

Decay Constants (1/y): 2.8761E-05 9.8500E-10 2.1158E-05 3.1840E-02
Leach Rate Constant (1/y): 2.2221E-06
Initial Pore Water Conc (Ci or mg/m**3): 2.4205E-07
Solubility Limited Mass (mg): 4.1314E+15
Solubility Limited Act (Ci): 2.5664E+11
Unsaturated Retardation Factor: 6.6861E+02
Mean Unsaturated Transit Time (y): 1.5165E+05
Leading Edge Arrival Time (y): 2.9753E+04
Aquifer Retardation Factor: 2.335E+02 1.096E+01 9.144E+02 7.483E+02
Minimum Peak Window Time (y): 2.9777E+04
Maximum Peak Window Time (y): 3.2710E+06

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m2/y): 1.7840E+03 Y Dispersion Coeff (m2/y): 3.5680E+02
NOTE: Concentrations and Doses Reported in Order of the Decay Chain
NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3): 3.211E-14 3.149E-15 3.493E-17 4.268E-17
Time of Peak (y): 1.7067E+05
Concentrations Averaged Between: 1.7066E+05 and 1.7069E+05 years
Average Concentration (Ci/m**3): 3.211E-14 3.149E-15 3.493E-17 4.268E-17
Maximum Dose: 2.131E-10 3.108E-12 1.093E-13 5.611E-13
Total Dose (all members): 2.168E-10
Maximum Allowable Inventory (Ci): 4.612E+03

Contaminant Data

Contaminant Name: Pu-240

Number of Progeny: 4
Progeny Names: U-236 Th-232 Ra-228 Th-228
Half Life (y): 6.560E+03 2.342E+07 1.410E+10 5.750E+00 1.910E+00
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 5.000E+03
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 2.400E+02
Initial mass/activity: 1.000E+00

Kd Unsat (ml/g): 1.400E+02
Kd Aquifer (ml/g): 5.600E+00 2.400E-01 4.000E+00 4.000E+00 4.000E+00
Risk/Dose Conversion Factor: 3.150E+02 4.210E+01 3.280E+01 2.480E+02 2.310E+02

Calculated Contaminant Values

Decay Constants (1/y): 1.0566E-04 2.9596E-08 4.9159E-11 1.2055E-01 3.6290E-01
Leach Rate Constant (1/y): 2.2221E-06
Initial Pore Water Conc (Ci or mg/m**3): 2.4205E-07
Solubility Limited Mass (mg): 4.1314E+15
Solubility Limited Act (Ci): 9.3889E+11
Unsaturated Retardation Factor: 6.6861E+02
Mean Unsaturated Transit Time (y): 8.5117E+04
Leading Edge Arrival Time (y): 2.9753E+04
Aquifer Retardation Factor: 2.335E+02 1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y): 2.9777E+04
Maximum Peak Window Time (y): 3.2045E+06

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02

NOTE: Concentrations and Doses Reported in Order of the Decay Chain

NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration

Peak Concentration (Ci/m**3): 3.592E-18 3.000E-16 7.841E-23 7.840E-23 7.840E-23

Time of Peak (y): 9.0375E+04

Concentrations Averaged Between: 9.0360E+04 and 9.0390E+04 years

Average Concentration (Ci/m**3): 3.592E-18 3.000E-16 7.841E-23 7.840E-23 7.840E-23

Maximum Dose: 2.376E-14 2.652E-13 5.401E-20 4.083E-19 3.803E-19

Total Dose (all members): 2.890E-13

Maximum Allowable Inventory (Ci): 3.460E+06

Contaminant Data

Contaminant Name: Tc-99

Number of Progeny: 0
Half Life (y): 2.130E+05
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 1.000E+03
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 9.900E+01
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 2.000E-01
Kd Aquifer (ml/g): 8.000E-03
Risk/Dose Conversion Factor: 1.400E+00

Calculated Contaminant Values

Decay Constants (1/y): 3.2542E-06

Leach Rate Constant (1/y): 1.1109E-05

Initial Pore Water Conc (Ci or mg/m**3): 1.2100E-06

Solubility Limited Mass (mg): 8.2642E+14

Solubility Limited Act (Ci): 1.4022E+10

Unsaturated Retardation Factor: 1.9537E+00

Mean Unsaturated Transit Time (y): 1.1107E+03

Leading Edge Arrival Time (y): 8.6942E+01

Aquifer Retardation Factor: 1.332E+00

Minimum Peak Window Time (y): 8.7076E+01

Maximum Peak Window Time (y): 6.2507E+05

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02

Peak Concentration (Ci/m**3): 7.629E-10

Time of Peak (y): 3.9579E+03

Concentrations Averaged Between: 3.9429E+03 and 3.9729E+03 years

Average Concentration (Ci/m**3): 7.629E-10

Maximum Dose: 2.243E-08

Maximum Allowable Inventory (Ci): 4.458E+01

Contaminant Data

Contaminant Name: U-234

Number of Progeny: 3
Progeny Names: Th-230 Ra-226 Pb-210
Half Life (y): 2.440E+05 7.540E+04 1.600E+03 2.230E+01
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 2.000E+03
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 2.340E+02
Initial mass/activity: 1.000E+00

Kd Unsat (ml/g): 6.000E+00
Kd Aquifer (ml/g): 2.400E-01 4.000E+00 4.000E+00 4.000E+00
Risk/Dose Conversion Factor: 4.440E+01 3.750E+01 2.960E+02 1.010E+03

Calculated Contaminant Values

Decay Constants (1/y): 2.8408E-06 9.1929E-06 4.3322E-04 3.1083E-02
Leach Rate Constant (1/y): 5.5550E-06
Initial Pore Water Conc (Ci or mg/m**3): 6.0508E-07
Solubility Limited Mass (mg): 1.6527E+15
Solubility Limited Act (Ci): 1.0356E+10
Unsaturated Retardation Factor: 2.9612E+01
Mean Unsaturated Transit Time (y): 1.6648E+04
Leading Edge Arrival Time (y): 1.3177E+03
Aquifer Retardation Factor: 1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y): 1.3188E+03
Maximum Peak Window Time (y): 1.2644E+06

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
NOTE: Concentrations and Doses Reported in Order of the Decay Chain
NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3): 2.979E-10 6.347E-12 6.058E-12 6.054E-12
Time of Peak (y): 3.9997E+04
Concentrations Averaged Between: 3.9982E+04 and 4.0012E+04 years
Average Concentration (Ci/m**3): 2.979E-10 6.347E-12 6.058E-12 6.054E-12
Maximum Dose: 2.777E-07 4.998E-09 3.766E-08 1.284E-07
Total Dose (all members): 4.488E-07
Maximum Allowable Inventory (Ci): 2.228E+00

Contaminant Data

Contaminant Name: U-235

Number of Progeny: 2
Progeny Names: Pa-231 Ac-227
Half Life (y): 7.040E+08 3.280E+04 2.180E+01
Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 2.000E+03
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 2.350E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 6.000E+00
Kd Aquifer (ml/g): 2.400E-01 2.200E+01 1.800E+01
Risk/Dose Conversion Factor: 4.700E+01 1.490E+02 6.260E+02

Calculated Contaminant Values

Decay Constants (1/y): 9.8458E-10 2.1133E-05 3.1796E-02
Leach Rate Constant (1/y): 5.5550E-06
Initial Pore Water Conc (Ci or mg/m**3): 6.0508E-07
Solubility Limited Mass (mg): 1.6527E+15
Solubility Limited Act (Ci): 3.5742E+06
Unsaturated Retardation Factor: 2.9612E+01
Mean Unsaturated Transit Time (y): 1.6850E+04
Leading Edge Arrival Time (y): 1.3177E+03
Aquifer Retardation Factor: 1.096E+01 9.144E+02 7.483E+02
Minimum Peak Window Time (y): 1.3188E+03
Maximum Peak Window Time (y): 1.2646E+06

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E+02
NOTE: Concentrations and Doses Reported in Order of the Decay Chain
NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration
Peak Concentration (Ci/m**3): 3.355E-10 2.438E-12 2.978E-12
Time of Peak (y): 4.4084E+04
Concentrations Averaged Between: 4.4069E+04 and 4.4099E+04 years
Average Concentration (Ci/m**3): 3.355E-10 2.438E-12 2.978E-12
Maximum Dose: 3.311E-07 7.629E-09 3.915E-08
Total Dose (all members): 3.779E-07
Maximum Allowable Inventory (Ci): 2.646E+00

Contaminant Data

Contaminant Name: U-238

Number of Progeny: 4
Progeny Names: U-234 Th-230 Ra-226 Pb-210
Half Life (y): 4.470E+09 2.440E+05 7.540E+04 1.600E+03 2.230E+01

Other Source Loss Rate (1/y): 0.000E+00
Kd Source (ml/g): 2.000E+03
Solubility Limit (mg/L): 1.000E+06
Molecular Weight (mg/L): 2.380E+02
Initial mass/activity: 1.000E+00
Kd Unsat (ml/g): 6.000E+00
Kd Aquifer (ml/g): 2.400E-01 2.400E-01 4.000E+00 4.000E+00 4.000E+00
Risk/Dose Conversion Factor: 6.200E+01 4.440E+01 3.750E+01 2.960E+02 1.010E+03

Calculated Contaminant Values

Decay Constants (1/y): 1.5507E-10 2.8408E-06 9.1929E-06 4.3322E-04 3.1083E-02
Leach Rate Constant (1/y): 5.5550E-06
Initial Pore Water Conc (Ci or mg/m**3): 6.0508E-07
Solubility Limited Mass (mg): 1.6527E+15
Solubility Limited Act (Ci): 5.5582E+05
Unsaturated Retardation Factor: 2.9612E+01
Mean Unsaturated Transit Time (y): 1.6850E+04
Leading Edge Arrival Time (y): 1.3177E+03
Aquifer Retardation Factor: 1.096E+01 1.096E+01 1.671E+02 1.671E+02 1.671E+02
Minimum Peak Window Time (y): 1.3188E+03
Maximum Peak Window Time (y): 1.2646E+06

Results for Receptor X = 1.21450E+02 Y = 0.00000E+00

X Dispersion Coeff (m²/y): 1.7840E+03 Y Dispersion Coeff (m²/y): 3.5680E-02

NOTE: Concentrations and Doses Reported in Order of the Decay Chain

NOTE: Progeny Concentrations are Reported at the Time of the Maximum Parent Concentration

Peak Concentration (Ci/m**3): 3.355E-10 3.949E-11 4.699E-13 4.266E-13 4.260E-13
Time of Peak (y): 4.4086E+04
Concentrations Averaged Between: 4.4071E+04 and 4.4101E+04 years
Average Concentration (Ci/m**3): 3.355E-10 3.949E-11 4.699E-13 4.266E-13 4.260E-13
Maximum Dose: 4.368E-07 3.682E-08 3.700E-10 2.652E-09 9.036E-09
Total Dose (all members): 4.857E-07
Maximum Allowable Inventory (Ci): 2.059E+00
Execution Time (Seconds): 6